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BY

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CONTENTS

I. INTRODUCTION

THE Museum has recently received a fine collection of several hundred specimens of ammonoids from Kurdistan which were presented by the management of the Iraq Petroleum Company Limited. The collection included a particularly interesting Tithonian fauna from one bed in the Upper Jurassic succession on Jebel Gara, near Amadia. A few specimens of this fauna were submitted to me many years ago, including some magnificent examples of entirely new ammonoids. While it was considered most desirable to make this new fauna known to the scientific world, the complete absence of any geological information prevented publication at that time. Now, however, by the kind permission of the Director-General of Economics, Iraq, and the management of the Iraq Petroleum Company Limited, I am in a position to publish the necessary stratigraphical details. An excellent section of the complete Upper Jurassic and Lower Cretaceous succession on Jebel Gara, drawn up by R. Wetzel (who collected the fossils), is available and I can give at least summaries of the various ammonoid faunas of the underlying and overlying beds at that locality, ranging up into the Valanginian. It will be readily admitted that the new Tithonian material is of the highest scientific interest and it is hoped that the present account will form a useful contribution to our knowledge of the fauna of the still somewhat controversial Tithonian stage.

I wish to express my indebtedness to Dr. R. G. S. Hudson for his continued help with information and his interest in the progress of the investigation.

II. STRATIGRAPHICAL SUMMARY

The ammonoids here described come from a bed (*i*) of black bituminous limestone and shale, 33 ft. thick, which is underlain by a considerable thickness (130 ft.) of beds (*d–h*) from which, I am informed, no fossils have so far been collected. Below that (beds *a–c*) the ammonites (including *Ataxioceras inconditum*, *Aulacostephanus* aff. *phorcus*, *Fontannes* sp.) indicate a Lower Kimmeridgian age, so that there must be a large gap in the succession, involving the equivalent of some 850 ft. of Kimmeridge Clay, not to mention the Portlandian and Lower Tithonian stages, if the writer's interpretation of the Upper Jurassic record be accepted (see p. 131).

I am stressing this because the collection contains one fossil, a well-preserved *Hybonoticeras* (better known as '*Waagenia*') of the common *hybonotum* type, that does not fit into the assemblage. It was said to come from the same bed as the other specimens and it has the same black, bituminous limestone matrix; it is also clearly not a derived fossil. But it formed part of an early collection of ammonites which I am informed were 'not collected with the same precision' as the Jebel Gara fossils of more recent collections. *Hybonoticeras*, being one of the most highly specialized ammonites, is unlikely to have had a long range, so that the obvious explanation is that this single Middle Kimmeridgian specimen must have come from some underlying bed, presumed to be unfossiliferous. This would reduce the gap to some extent, but it might be held to support the view of those who place the Middle Kimmeridgian *lithographica* (or *steraspis*) zone, i.e. the horizon of *Hybonoticeras*, immediately below, or even in, the Tithonian.

When discussing the age of the fauna described in these pages in a final chapter, I shall attempt to show that the gap between the horizon of *Hybonoticeras* and the Tithonian is very real. Here it may suffice to repeat that between the *Gravesia* Beds, the home of *Hybonoticeras* (in more southern latitudes), and the base of the Tithonian as here understood, there are 910 ft. of Upper Kimmeridgian and Portlandian strata in England, many of them teeming with ammonites. The Pavlovids of the higher of these beds link up with the *pseudocolubrinus* and *colubrinoides* type of ammonites of the Lower and Middle Tithonian, but have not the remotest affinity with the Berriasellids and other ammonites of the Upper Tithonian.

Above the bed (*i*) that yielded the present fauna follows another bed (*j*), 45 ft. thick, which contains abundant ammonites. Those collected from the scree of this bed, unfortunately all crushed impressions, include *Haploceras*, *Substeueroceras*, and especially *Grayiceras* (= '*Simbirskites*'), similar to forms of the Spiti Shales; but there are as yet no examples of *Berriasella* or late *Parodontoceras* of what we used to call the *privasensis* zone of the uppermost Tithonian. In fact, after an interval of unfossiliferous beds (*k–r*) of no less than 145 ft. in thickness, there follow three more beds (*s–u*) that have yielded Tithonian ammonites. First, the basal bed (*s*), 193 ft. above the main Tithonian assemblage here described, contains a few forms of *Parodontoceras* and at least two genera and a number of new species of uncoiled ammonoids, comparable to some '*Leptoceras*' and '*Ancyloceras*' figured by Mazenot (1939) from the south of France. But as these forms range through the Tithonian and Berriasian up into the Valanginian, they are not of particular value for dating, at least in the present state of our knowledge. On the other hand, the succeeding beds (*t*, *u*), 60 ft. higher, have yielded specimens of *Parodontoceras*, *Berriasella*, and *Protacanthodiscus*. As these are still Tithonian in my opinion and even include a *Berriasella* of the *privasensis* group, they are considered to represent the top of the Jurassic, especially since the next higher bed (*x*), 16 ft. thick and 16 ft. higher in the sequence, included a *Berriasella calisto* (d'Orbigny), complete with aperture and lappet. This last assemblage marks the base of the Cretaceous. It is hoped to describe the ammonites of these higher beds in the Tithonian, and the many new forms of the Berriasian or Infra-Valanginian ('*calistoides*' and *boissieri* zones) in a separate paper.

III. SYSTEMATIC DESCRIPTIONS

Family OPPELIDAE Haug, emend. Spath, 1928

Sub-family Streblitinae Spath, 1925

Genus ***OXYLENTICERAS*** gen. nov.

Genotype: *O. lepidum* sp. nov., Plate 6, figs. 1–5.

Diagnosis: Compressed oxycones, with closed umbilicus. Greatest whorl-thickness at umbilical callosity. Almost flat sides, with (typically) only faint striae of growth.

Whorl-section wedge-shaped, with very sharp venter. Suture-line not clearly visible. Body-chamber about half a whorl. Aperture apparently without rostrum.

REMARKS: This Oppelid is obviously different from any Tithonian genus so far described, and although it is as yet incompletely known, it would be misleading to refer it provisionally to *Neochetoceras* or *Streblites*, as I thought of doing at one time. The generic features are those of the genotype described below and it may suffice to state briefly that *Oxylenticeras* has the flat, smooth, and involute shell of *Paralenticeras*, the oxynote venter of *Oxynoticeras*, but the rather finely divided suture-line of the Oppelidae, so far as can be seen, and not of the simplified *Garniericeras* (see Spath, 1947: 14, text-fig. 2).

In its comparatively large siphuncle and half-whorl of body-chamber the genotype species shows some resemblance to *Neochetoceras steraspis* Oppel sp. (1863: pl. lxix, fig. 12), but this has an open umbilicus, crescentic, not straight, outer ribs, and it is not truly oxynote. *'Oppelia' paternoi* Di-Stefano sp. (1884: 31, pl. ii, fig. 12), with a small umbilicus and a sharpened periphery, is another form of *Neochetoceras*. I previously (1925: 117) referred it to *Streblites*, but it also is not closely comparable to the group here described. The other small and oxynote forms of *Neochetoceras* described in geological literature are associated with earlier faunas.

Reference of the present group to *Streblites* would have been still more open to criticism. In the narrower sense, that is as applied to the *tenuilobatus* group, this genus is characterized by the more or less nodate primary ribs; the periodic tubercles of the secondary ribs are less constant. This type of ornamentation is well shown in the original figure (Quenstedt, 1846: pl. ix, fig. 16) and in *S. frotho* Oppel sp. (1862: pl. 1, figs. 1*a*, *b*). It is true that *S. weinlandi* Oppel sp. (1863: pl. liii, figs. 1*a*, *b*) somewhat resembles the form here described, at least in the curvature of the striae of growth; but it still has the *Streblites* keel instead of an oxynote venter.

Substreblites zonarius Oppel sp. which persists, apparently unchanged, from the Tithonian into the Valanginian and perhaps even into the Hauterivian (Spath, 1939*a*: 139) still has the typical *Streblites* aspect, as have the examples before me (of *S. folgariacus* Oppel sp. ?) from the Lower Tithonian *Virgatosphinctes* Marls of Antsalova, Madagascar, as much as the Valanginian *S. ambikyensis*. Besairie sp. (1936: 143, pl. xiii, figs. 16, 17). These forms have the high external lobe of *Uhligites*, but not its distinctive ornamentation and punctate keel; and instead of developing a rounded venter, *Substreblites* retains the characteristic smooth siphonal band which supported the very prominent keel of the test. *Substreblites* is now included in Streblitinae, as well as *Cyrtosiceras* Hyatt, contrary to the opinion expressed in 1925 (p. 115) and 1928 (p. 148) when I doubted the longevity of the Streblitid stock and also wrongly placed *S. motutaranus* G. Boehm (1911: 17, pl. ii, figs. 5*a*, *b*) in *Uhligites*, instead of *Substreblites*.

Another Tithonian Streblitid, namely, *Gymnodiscoceras* Spath, 1925 (= group of *Oppelia acucincta* Blanford sp.), not becoming oxynote and having strongly sigmoidal ribbing, is less closely comparable to the form here described than is *Substreblites*. Whereas the exact range of *Gymnodiscoceras* is still uncertain, a Streblitid that has actually been found in the Middle Tithonian together with *Pseudolissoceras zitteli* is *Oppelia waageni* Zittel (see Burckhardt, 1930: table 11 to p. 112). In 1925 I compared that species to the Somaliland *Neochetoceras simile* Spath, but both lack the sharp venter of the present form, as does '*Oppelia*' *strambergensis* Blaschke (1911: 154, pl. i, figs. 6, 7) of the Upper Tithonian.

Oxylenticeras lepidum sp. nov.

PLATE 6, FIGS. 1–5

This species is based on the completely septate example figured in Plate 6, fig. 1, which has the following dimensions:

Diameter . .	58 mm.
Height of last whorl	67% of the diameter
Thickness of last whorl	28% ,, ,,
Umbilicus . .	0% ,, ,,

The extremely sharp keel is broken off all round; but it is visible at the beginning of the outer whorl. The periphery shown in the illustration thus is formed alternatively by the solid siphuncle or, where this has fallen out, by the groove in which it lay. The whorl-side is perfectly smooth, partly because in an endeavour to expose the suture-lines the delicate striae of growth were obliterated. There is no suspicion of a spiral groove at the middle of the side, but the interlocking of the elements of the closely packed suture-lines simulates the presence of spiral lines. No individual septal edge, unfortunately, was sufficiently clearly exposed for reconstruction or comparison with the suture-line of other Streblitids or similarly oxynote *Garniericeras*.

A second specimen of 60 mm. diameter (Plate 6, fig. 2*a*) has just over half a whorl of body-chamber, but this is crushed and as in all the other specimens only the septate whorls are solid. These are figured separately in fig. 2*b*, and they well show the delicate ornamentation, consisting of sigmoidal striae on the inner whorl-side which become perfectly straight on the outer half. In another example (Plate 6, fig. 3) from a different locality this ornamentation is slightly more pronounced, and shows a curious resemblance to that of *Oxynoticeras wingravei* Spath (see Wright, 1881: pl. xlviii, fig. 1), except that the umbilical portion of the ribs is more sigmoidal in the present form.

There seems to be some variation also in thickness, and this is not due to the mode of preservation. The greatest whorl-thickness is at the umbilical callosity; it is well seen only in the holotype, which must have been originally of at least 90 mm. diameter. One of the compressed examples figured in Plate 6, fig. 4, has a whorl-thickness of only 23 per cent. at 30 mm. diameter, while what seems to be a more inflated variety (Plate 6, fig. 5) has a whorl-thickness of 26 per cent. at 23 mm. diameter. This last, however, like the more strongly ornamented form (Plate 6, fig. 3) comes from a different locality, so that it is possible that the many smaller oxynote forms here united with the large holotype in one species include distinct variations.

Family HAPLOCERATIDAE Zittel, emend. Spath, 1928[1]

Genus *GLOCHICERAS* Hyatt, 1900

Glochiceras (?) sp. juv. ind.

PLATE 6, FIG. 6

The immature example here figured and several other young specimens are too small for definite identification, but they are obviously different from externally similar inner whorls of *Hildoglochiceras*, e.g. the East African *H. spira* Zwierzycki sp. (1914: 49, pl. v, figs. 11–13). A series of the Madagascan form of *H. kobelli* (Oppel) figured by Besairie (1936: pl. x, fig. 12), which the Museum owes to the kindness of that author, shows how at a diameter of only 20 mm. or less the inner half of the whorl-side changes into a high umbilical slope, bordered by the raised inner edge of the spiral groove. In the present form, on the other hand, the spiral groove is well away from the perpendicular and low umbilical wall and the flattened inner half of the whorl-side is even wider than the outer. This is certainly more reminiscent of the Kimmeridgian *Glochiceras* than the Lower Tithonian *Hildoglochiceras*.

The specimen here figured has a whorl-thickness of 24 per cent. of the diameter (25 mm.), but many species of the two genera mentioned have a similarly flattened whorl-section. The present form, however, has a distinctly tabulate venter which could not have changed to the acute periphery of *Hildoglochiceras*. The ventro-lateral edges are not sharply defined, yet unmistakable, and the narrow venter is absolutely flat, and like the sides perfectly smooth. This ventral flattening is thus quite different from the wide venter developed in some forms of *Haploceras* like *H. carachtheis* Oppel sp., or in the Valanginian *Neolissoceras grasianum* (d'Orbigny). Unfortunately the suture-line is not visible.

This form is more evolute than Oppel's original Kimmeridgian *Amm. nimbatus* (1863: 191, pl. lii, figs. 5*a*, *b*), the genotype of *Glochiceras*, but similar species seem to occur right through the Upper Jurassic, as Steuer's record of Oppel's species from the Argentine Tithonian shows. The latter form may be as distinct from the original *G. nimbatum* as it is from the smooth species here described; but it is interesting to note that there are two impressions in the collection from Shiranish Islam that may be compared to the Argentine form. One (C.41108) has the anguliradiate and comparatively strong striae of growth unprojected on the venter, that is to say, the outer half of the ribs runs up to the periphery in a straight line. In the other example (C.41189) only the lateral bend in the striae of growth was conspicuous enough to leave its mark on the impression of the smooth side. This type of ornamentation is found in some forms of *Brightia* (see *Amm. hecticus* in Quenstedt, 1849: pl. viii,

[1] The genotype of *Haploceras* is *Amm. elimatus* Oppel, and a recent attempt by Breistroffer (1947) to apply that name to the Cretaceous *grasianus* group and to substitute a new generic name for the typical Tithonian species must be rejected. Favre in 1873 did not emend the genus *Haploceras* Zittel. He merely cited three French species, with the name of one misspelt, as 'examples'. This citation has no legal standing; apart from that it did not even include one of the typical Tithonian species which had been especially characterized by Zittel as representing the acme of development in *Haploceras*. According to Article 30, II. *g* of the Rules, the meaning of the expression 'select the type' is to be rigidly construed. 'Mention of a species as an illustration or example of a genus does not constitute a selection of a type.' The family-name Haploceratidae therefore remains unchanged.

figs. 1*a*, 4*a*); only the knee-bend there is almost tuberculate, distantly spaced and combined with outer ribs, i.e. altogether more extreme than the feeble ornamentation of these forms of *Glochiceras*. These two examples, however, may well belong to two other forms of the genus.

The present species, on the contrary, is much like the small *Amm. erato*, figured by d'Orbigny (1850: pl. 201, figs. 5–6 only), though this is more compressed laterally, has the spiral groove nearer the umbilicus, and lacks the ventral flattening.

Glochiceras (?) sp. nov.

PLATE 6, FIG. 7

The body-chamber fragment here figured is interesting on account of its resemblance to a similar terminal portion figured by R. W. Imlay (1939: pl. iv, fig. 10) and referred to his *G. diaboli*. The latter fragment is even larger and it has a much more pronounced lateral bend in the lines of growth and the ribs, almost as in *Hildoglochiceras*, but it comes from the Kimmeridgian (*Idoceras* beds). Its venter also is broadly rounded so that the resemblance is probably accidental. The forms of *Hildoglochiceras* figured by the same author, e.g. *H. grossicostatum* Imlay (1939: pl. iii, figs. 1–7, 9–11) may thus be more closely related to the present species than the example of *G. diaboli* above cited; yet they also have a more angular radial line. In the form here discussed there is no trace of a spiral depression at the lateral angularity of the striae of growth and ribs which are parallel to the mouth-border. The flattened inner half of the whorl-side is thus entirely different from the wide and steep umbilical slope of the typical *Hildoglochiceras latistrigatum* (Uhlig) and *H. kobelli* (Oppel) from the Spiti Shales.

Since the periphery is damaged, generic identification must remain uncertain. It is perhaps improbable that the present fragment represents a large *Semiformiceras* of the type of *Oppelia microps* (Oppel), figured by Zittel (1870: pl. xxviii, fig. 15), large examples of which might be expected to develop a ventral groove, instead of the row of beads, and to become smooth.

The East African *Haploceras priscum* Zwierzycki (1914: 50, pl. v, figs. 5, 6) might have developed a body-chamber with the coarse ornamentation of the present form, if it grew to that size. The resemblance to the Kachh *Glochiceras ? propinquum* (Waagen) with which Zwierzycki compared his species, is only superficial (see Spath, 1928: 158).

Genus *PSEUDOLISSOCERAS* Spath, 1925

Pseudolissoceras zitteli (Burckhardt)

PLATE 6, FIGS. 8*a*–*c*

1903 *Neumayria zitteli* Burckhardt, p. 55, pl. x, figs. 1–8.
1907 *Neumayria zitteli* Burckhardt: Haupt, p. 200, pl. vii, figs. 3*a*, *b*.
1925 *Pseudolissoceras zitteli* (Burckhardt) Spath, p. 113.
1926 *Haploceras* (*Pseudolissoceras*) *zitteli* (Burckhardt) Krantz, p. 436, pl. xvii, figs. 4–5.
1928 *Pseudolissoceras zitteli* (Burckhardt): Krantz, p. 18, pl. i, fig. 6.
1931 *Pseudolissoceras zitteli* (Burckhardt): Weaver, p. 401, pl. xliii, fig. 291.
1942 *Pseudolissoceras zitteli* (Burckhardt): Imlay, p. 1443, pl. iv, figs. 1–4, 7, 8, 11, 12.

The Kurdistan examples show such good agreement with the Argentine types that specific identity is suggested. The specimen figured in Plate 6, fig. 8*a*, and a slightly larger example (figs. 8*b*, *c*) have the following dimensions:

Diameter . . .	27 mm.	32 mm.
Height of the last whorl .	51%	51% of the diameter
Thickness of the last whorl	32%	31% ,, ,,
Umbilicus . . .	20%	21% ,, ,,

Both are casts and entirely smooth, but the first example retains a part of the crushed outer whorl, showing faint and almost straight ribs, like the large specimen figured by Krantz. The suture-line is visible on both examples, but only in parts. It differs from that figured by Burckhardt in having a larger second lateral lobe, like that of the more evolute *P. planiusculum* Zittel sp. (1870: pl. xxviii, fig. 3). The external lobe, seen in only one place, is shallow and the proportions of the elements are remarkably similar in the three forms, even if the external saddle seems to be slightly lower and broader in the examples here figured.

There are over twenty specimens, but most of them are smaller than the two here figured and some are only impressions. At 10 mm. diameter the whorl-section is only slightly higher than wide and at 5 mm. it is circular while the umbilicus is comparatively open. In a few of the small individuals there is the merest suspicion of a spiral groove, as in so many other Haploceratids. There is no sign, however, in any of the specimens, of a depression, just outside the prominent umbilical edge, as shown in Haupt's fig. 4. The present examples, in fact, all belong to what has been called the variety with the more inflated whorl-section, figured in Haupt's fig. 3.

The impression of an unusually large example (No. C.41188), comparable to that figured by Krantz in 1928, seems to agree with it in most respects, so far as can be seen. Only the lateral bend in the radial line is slightly more marked and the striae are more pronounced near what appears to have been the mouth-border at about 115–120 mm. diameter. The lateral angularity of the radial line, it may be added, is not nearly so distinct as in *Haploceras elimatum* Oppel sp. (in Zittel, 1868: pl. xiii, fig. 7) and the presence of an umbilical rim is in favour of comparison with *Pseudolissoceras*. But in view of the discovery of a *Hybonoticeras* in the same collection (p. 96) it is not impossible that the impression belongs to a form of *Glochiceras* of the *fialar* group of the Kimmeridgian. It therefore has to be left indeterminate.

Pseudolissoceras advena sp. nov.

Plate 6, figs. 9, 10; Plate 8, fig. 10

This form is almost a homoeomorph of the Argentine Middle Tithonian '*Oppelia*' *perlaevis* Steuer (1897: 73, pl. xx, figs. 7–9), but it has a larger umbilicus and a distinct umbilical edge, also a suture-line that suggests reference to *Pseudolissoceras*. Steuer gave the whorl-height of his species as 44 per cent. of the diameter, but this is less than the (possibly inaccurate) drawing shows. According to Krantz (1928: 14) the height may be as much as 58 per cent., at least in a comparable Andine form, whereas in the holotype of *P. advena* here figured (fig. 9*a*) the whorl-height is 50 per cent. The width of the umbilicus is correspondingly greater (19 per cent. instead of 10 or 12 per cent.), while the whorl-thickness is only slightly less (25 per cent. instead of 27–28 per cent.). The sides are flat and almost smooth, the striae of growth being extremely fine, and there are occasional irregular folds, as in Steuer's species. The holotype has two *Beudanticeras*-like constrictions, faint but distinct enough for one to be marked even on the periphery.

At 16 mm. diameter the whorl-thickness is 37 per cent. and the evenly arched venter is comparable to that of '*Oppelia*' *perglabra* Steuer (1897: 74, pl. xxi, figs. 13–15) which, however, has no umbilical edge and more sigmoidal striation. The holotype is entirely septate and therefore could well have been as large as Steuer's largest example of his '*Oppelia*' *perlaevis*.

A specimen from Shiranish Islam (fig. 10) of possibly a slightly different age (see p. 132) has a diameter of 49 mm. and an umbilicus that seems larger because the slope is steep and the edge is very distinct. The whorl-section is also thinner (although the specimen is partly crushed), at least at the periphery, all characters in which the variety of *P. zitteli* with high and compressed section figured by Haupt (1907: 200, pl. vii, fig. 4) differs from the holotype of *P. advena*. It will be noticed that the suture-line of Haupt's Andine form is more complex than that of the typical *P. zitteli*. In the holotype of *P. advena* the suture-line is slightly corroded (see Plate 6, fig. 9*a*) but also less simplified than in *P. zitteli*, although of the same pattern. There is a similar shallow external lobe, a broad, bifid saddle, and two wide lateral lobes. The small size of the first lateral saddle alone is against reference of this form to *Haploceras*. Since the suture-line of the Shiranish Islam example above mentioned is slightly more complex than that of the holotype of *P. advena*, it may perhaps be looked upon as a transition from the Haploceratid main-stock to *Pseudolissoceras*.

A smaller example of 26 mm. diameter (figs. 9*c*, *d*) differs from the holotype chiefly in having no constrictions, but it is slightly malformed, the umbilical rim with its spiral depression being less conspicuous on the side not figured. A second Shiranish Islam specimen of 34 mm. diameter well shows the very fine Phylloceratid striation, but it has no umbilical edge, which makes it look different from the other specimens; its simple suture-line (Plate 8, fig. 10), with asymmetrical ventral lobe, is that of *P. advena*. It may be a variety corresponding to the typical forms of *P. zitteli*, without umbilical rim.

Uhlig (1903: 38) considered it uncertain whether Steuer's '*Oppelia*' *perlaevis* was related to *Streblites* (*tenuilobatus* group) because the suture-line 'permitted of various interpretations'. Steuer's drawing of the suture-line is obviously not very accurate, but it is a *Haploceras* suture-line, though it may be noted that Uhlig did not refer the species to that genus. Apart from the suture-line, the *Beudanticeras*-like whorl-shape of the present form, with a tendency of the whorl-sides to converge, not diverge, as in many species of *Haploceras*, suggests a different stock. Since the suture-line of the form here described is that of *Pseudolissoceras*, if more complex, the similarity in whorl-shape to '*Oppelia*' *perlaevis* is not considered of any significance.

Genus *LAMELLAPTYCHUS* Trauth, 1927

Lamellaptychus sp. ind.

PLATE 10, FIG. 12

The single pair of *aptychi* in the collection, about 30 mm. long and embedded in a piece of shale so as to show the striations of the concave sides, can be compared to the two *aptychi* in the body-chamber of a *Neochetoceras steraspis* figured by Oppel (1863: pl. lxix, fig. 2). The broader end, however, differs in having the striae much less curved, where they meet the internal edge, whereas in Oppel's figure and in numerous specimens in the Haeberlein collection in the Museum these striae are very strongly curved.

This comparative straightness of the lineation suggests comparison with *L. crassissimus* Haupt, as figured in Weaver (1931: pl. 58, fig. 371, enlarged) and Trauth (1936: pl. iii, fig. 13, natural size); but the massive *aptychus* of Haupt's original figure (1907: pl. viii, figs. 3*a*, *b*) described as *Punctaptychus* is not at all like the present example. Another comparable form is *Aptychus* sp. figured by Steuer (1897: pl. xxiv, fig. 3) from Cineguita I, i.e. from below the *zitteli* zone in Burckhardt (1930); and the association of this with Haploceratids as well as with *lamellaptychi* of the *beyrichi* type suggests that the *aptychi* belonged to some form of *Haploceras*. An indeterminable, flattened impression of a Haploceratid, in fact, occurs on the same slab of shale as the pair of *aptychi* here described.

Whereas the example just referred to comes from Shiranish Islam, an impression of a pair of minute *lamellaptychi* is said to be from the Ammonite Bed on Jebel Gara; only it has a Perisphinctid in the same piece of matrix that may be Kimmeridgian. The *aptychi*, in any case, are too small to be identified, even if they were of Tithonian age.

Family PERISPHINCTIDAE Hyatt, 1900

Sub-family VIRGATOSPHINCTINAE Spath, 1931

Genus ***PHANEROSTEPHANUS*** gen. nov.

GENOTYPE: *P. subsenex* sp. nov. (Plate 7, figs. 5*a*, *b*).

DIAGNOSIS: More or less evolute shells with arched venters and inner whorls like *Virgatosphinctes*. On the outer whorls, however, the costation tends to disappear, both on the periphery and on the sides, until only umbilical bullae remain. Greatest whorl-thickness therefore gradually moves from the middle of the whorl-side to umbilical border. Slope steep, but rounded. Varying number of shallow and almost straight constrictions. Body-chamber about two-thirds of the last whorl. Mouth-border with a broad, shallow contraction, apparently confined to the sides, but with ventral lappet. Suture-line complex at first, tending to simplify at the end; broad, unsymmetrically bifid external saddle and irregularly trifid first lateral lobe, as deep as the external lobe or deeper. Second lateral lobe and two auxiliary lobes short and oblique, as in *Sublithacoceras*, but simpler (Plate 7, fig. 6*b*).

REMARKS: I was at first inclined to compare one of the forms now included in this new genus (*P. hudsoni* sp. nov.) with a group of Somaliland ammonites (genus

Pseudoclambites Spath, 1925) provisionally attached to the family Aspidoceratidae. Apart, however, from the fact that both genera tend to lose their ornamentation and develop smooth outer whorls, the resemblance is not very close. The inner whorls are different so far as can be seen and there is no suggestion of a ventral sulcus in *Phanerostephanus*, such as is shown in *Pseudoclambites costatus* Spath (1935: pl. xxv, fig. 6) as well as in the two species described in 1925.

The holotype of *Phanerostephanus*, however, has decidedly more affinity with the genus *Sublithacoceras* Spath, 1925, which also has Virgatosphinctid inner whorls, but tends to lose the ribbing altogether, instead of developing umbilical tubercles. A form like *S. dacquei* Schneid sp. (1915*a*: 359, pl. xxvi, fig. 3) might be considered intermediate in this respect, but the genotype, *S. penicillatus* Schneid sp. (1915*a*: 329, pl. xviii, fig. 3) shows that the ribbing is completely lost, even if the primaries do not disappear until after the secondary ribs. There is, of course, the difference in size, and the suture-line of *Sublithacoceras* is very complex, has numerous pendent auxiliaries, and a very deep and symmetrical principal lobe.

The true *Virgatosphinctes* Uhlig, i.e. the *broilii*-group, as restricted in 1931 (Spath: 463) also loses its ribbing, but only at very large diameters, and before that the ribs tend to unite in bundles. In *P. subsenex*, on the other hand, the 'Pseudovirgatitid' ribbing with its characteristic constrictions is much more like that of the Neuburg species of *Sublithacoceras*; and in appraising the systematic position of *Phanerostephanus* the almost total absence of a ventral groove or smooth zone seen in *Virgatosphinctes transitorius* or *Sublithacoceras senex* (Oppel) is considered as significant as the presence of umbilical nodes on the body-chamber of *P. subsenex* as well as in the extreme *P. hudsoni*. Moreover, *Phanerostephanus* is connected by transitions with the new genus *Nothostephanus*, as mentioned below (p. 114), and their affinities, whether Virgatosphinctid or Virgatitid, are, in my opinion, certainly not with the Berriasellids *Dalmasiceras* or '*Neocomites*' of the *occitanicus* group, though these have comparable umbilical tubercles. *Phanerostephanus*, in short, is a Perisphinctid, and not a Berriasellid. It may be a modified offshoot of the same stock that produced *Virgatosphinctes transitorius* and its allies, the last representatives of the group in the Tithonian, but it has no 'Hoplitid' features.

Phanerostephanus subsenex sp. nov.

Plate 6, fig. 15; Plate 7, figs. 5–7

This species is based on the example figured in Plate 7, fig. 5, the (restored) dimensions of which are as follows:

Diameter . . .	97 mm.
Height of the last whorl	?42% of the diameter
Thickness of the last whorl	?36% ,, ,,
Width of the umbilicus .	38% ,, ,,

The whorl-section is ovate, with slightly flattened sides and an evenly arched venter. The inner whorls are more depressed and bear bifurcating ribs with the secondary branches slightly projected on the venter. After about 25 mm. diameter triplicate ribs appear, with the anterior branch coming off at a lower level than the remaining two secondaries and followed by a constriction, inclined forwards and succeeded by a single rib. There may also be pairs of bifurcating ribs, joining at the umbilical edge, or even bi- and trifurcating ribs, uniting just before a constriction. At 50 mm. diameter the branching becomes somewhat less clearly defined, owing to the flattening of the sides; and at the end of the septate stage (64 mm.) the secondaries tend to disappear while the primary ribs develop blunt bullae and become more distantly spaced. The body-chamber occupies about two-thirds of the outer whorl and its sides and venter are perfectly smooth. The mouth-border is almost intact on the side not figured and is preceded by a faint ridge, followed by a constriction, but the ventral lappet is broken off. The suture-line is visible near the end of the septate portion and is more complex than that of *P. hudsoni*, without apparent simplification.

The smaller example figured in Plate 7, fig. 6, has its last half-whorl crushed accidentally and the early constrictions seem rather oblique, but like a third and similar specimen (fig. 7) it probably belongs to the same form. They might easily be taken for the inner whorls of a Perisphinctid like *P.* aff. *transitorius* (Oppel) figured by Burckhardt (1903: 40, pl. v, figs. 7–9) for, according to that author, even typical Stramberg examples of Oppel's species may lack the characteristic ventral sulcus on the earlier whorls. The obvious distinction then is the projection of the peripheral ribbing in *Phanerostephanus*. It may be added, however, that a young and therefore doubtful, although solid and well-preserved specimen (pl. 9, fig. 7; no. C.41185) has a ventral sulcus that disappears at a diameter of about 20 mm. This small example and an impression (No. C.41190) may represent a compressed variety of *P. subsenex* or even a new species, transitional to *P. intermedius*, only less closely ribbed.

Steuer's badly drawn Argentine example of *Amm. transitorius* (1897: 32, pl. xxix, fig. 6), significantly referred to *Reineckeia*, is not closely comparable to the form here described; but Toucas's larger Chomérac specimen of his *Perisphinctes transitorius* (1890: 599, pl. xvi, figs. 5*a*, *b*) differs chiefly in retaining regular bifurcation to a later stage. *Perisphinctes chalmasi* Kilian (1889: 652, pl. xxviii, fig. 1) from the Lower Tithonian of Andalusia may possibly represent a development comparable to the form under discussion, tending to umbilical tuberculation and smooth outer whorl; but it lacks the typical constrictions and its comparison by Kilian with much earlier (Kimmeridgian) species may not be so inept as the occurrence 'with *P. transitorius*' suggests.

One crushed example (No. C.41200) which to a diameter of about 25 mm. appears to be much like the young *P. subsenex* figured on Plate 7, fig. 6, has the peripheral ribs extremely projected on the outer whorl (diameter = just over 40 mm.); but this sudden change in the costation is so unnatural that it can only be due to oblique crushing. It certainly gives the ammonite the appearance of a *Kossmatia*, but in reality the form is believed to be a transition between *Phanerostephanus* and *Notho-stephanus*. Its affinities with the latter are indicated by the fact that the triplicate ribs have the longest branch behind the bifid pair instead of in front, as in *Phanero-stephanus* and most of the other Upper Jurassic Perisphinctids.

After the present account was already completed and too late for incorporation in the text or the plates, an example of a new *Phanerostephanus* reached me which is almost exactly half-way between *P. subsenex* and *P. hudsoni*, but is also distinctly transitional to the more involute *Nothostephanus*. It has about three-quarters of the outer whorl belonging to the body-chamber, at just over 100 mm. diameter, and its proportions (100–41–31–33) are intermediate between those of the two species mentioned. But the specimen was one of an assemblage found loose (with other species and at least one Lower Kimmeridgian *Ataxioceras*) at Rowanduz and Zakho, Iraq.

Phanerostephanus hudsoni sp. nov.

PLATE 8, FIGS. 1, 2

The complete holotype of this species (No. C.40746) has the following dimensions:

Diameter . . .	66 mm.
Height of the last whorl	38% of the diameter
Thickness of the last whorl	30% ,, ,,
Width of umbilicus .	42% ,, ,,

To the diagnostic features already mentioned in the generic description it may be added that although the whorl-section is widest at the umbilical tubercle, the ventral portion is broadly arched, not compressed, and the sides are only slightly convergent. The test is extraordinarily thick near the aperture, but not where it is flaking off on the venter (fig. 1*b*). The suture-line is not seen in the holotype, but the siphuncle is exposed on the first third of the outer whorl, to the second constriction. This is not so deep as the first, though more distinct than the third. These constrictions are only slightly inclined forwards and the anterior rim is more pronounced than the posterior. There is only a very slight ventral sinus, so that the constrictions are convex forwards on the periphery.

The suture-line is well exposed on the fragment (No. C.40749) illustrated in Plate 8, figs. 2*a*, *b*, which is entirely septate and thus belonged to an example considerably larger than the holotype. In the still larger species described above as *P. subsenex*, with a somewhat less simple suture-line, the costation remains to a diameter of 60 mm., but the inner whorls are believed to be more or less identical. In the present form the change begins already at about 25 mm. diameter, though the ventral costation is visible to 35 mm. After that, especially between the first and second constrictions of the outer whorl, only a few indistinct and irregular striae seem to meet at the umbilical bullae and probably represent lines of growth since the cast is entirely smooth.

Phanerostephanus intermedius sp. nov.

PLATE 8, FIGS. 3, 6; PLATE 10, FIG. 11

Only the inner whorls of the holotype are here figured since the outer whorl is badly crushed. The figure thus represents the septate stage and only the beginning of the body-chamber. At that stage the dimensions are:

Diameter . . .	49 mm.
Height of the last whorl	37% of the diameter
Thickness of the last whorl	28% ,, ,,
Width of the umbilicus .	36% ,, ,,

The remainder of the crushed body-chamber is preserved as an impression, representing over half a whorl, so that the size of the complete specimen was approximately 75 mm. The whorl-section is compressed laterally, with almost parallel sides and an evenly arched venter. The ribs are strongly inclined forwards in the umbilicus, rather irregular, and there are occasional oblique constrictions. On the last whorl of the septate stage the ribs are rather closely spaced, especially the secondaries which result from the bifurcation and trifurcation of the primaries. In the trifurcating ribs the anterior branch is the lowest, but even the remaining two branches bifurcate lower down on the whorl-side than the intervening biplicate ribs. All the ribs are fairly sharp and well defined, with the anterior slope less steep than the posterior. There are about four constrictions to the whorl, apparently getting shallower towards the beginning of the body-chamber. The latter has the secondary ribs somewhat less closely spaced than before and they are only slightly projected forwards on the periphery. The points of furcation become indistinct, but it is only near the aperture that the ribs of the lateral area degenerate and lose their regularity. No umbilical nodes are visible as the inner part of the body-chamber has been crushed on to the unfigured side of the septate whorls represented in Plate 8, fig. 3*a*.

The suture-line has a large, unsymmetrically bifid external saddle and a deep external lobe, with a high median saddle. The first lateral lobe is trifid but less deep than the external lobe. Its deepest part is already beyond the middle of the whorl-side. The lateral saddles and the auxiliaries are apparently like the corresponding elements in *P. hudsoni* (fig. 2), but not clearly exposed. The suture-line on the whole is comparable to that of *Virgatosphinctes transitorius* (Oppel) as figured in Zittel (1868: pl. xxii, fig. 4), but the lateral saddles are less elongated.

The only other solid example (No. C.41192), part of an ammonite of about 80 mm. diameter, has the characteristic fine and sharp costation, but this is slightly more inclined forwards. What remains of the outer whorl includes apparently the last septal edge. Although there are primary ribs on the umbilical shoulder of this outer portion, the sides and periphery are smooth, probably owing to corrosion, for the venter retains a few secondary ribs where the beginning of the body-chamber is crushed in and escaped erosion. The slender whorl-section, comparable to that of *Kossmatia desmidoptycha* Uhlig (1910: pl. xlvii, fig. 2), is typical, but what resemblance there may be to the genus *Kossmatia* (genotype: *K. tenuistriata* Gray sp.) is due chiefly to the sharpness of the fine ribbing.

This species is less completely known than the typical *P. subsenex*, but this is partly due to accidents of preservation. It appears to be the commonest species of the genus. There are many impressions similar to that figured in Plate 10, fig. 11, which do not show the later smooth stage and therefore could be the young of *Virgatosphinctes* of the *transitorius* group. But the impressions having a diameter of more than 40 or 45 mm. (Plate 8, fig. 6) begin to show loss of lateral ribbing, like the form described below as *P. dalmasiformis* sp. nov. It is not certain, in view of slight differences in the closeness of the ribbing, that all the impressions belong to one species and its varieties. Thus the last example here figured (Plate 8, fig. 6) is, perhaps, somewhat transitional to *P. dalmasiformis*. It shows at least ten constrictions on the outer whorl, a feature which is reminiscent of many of Schneid's Neuburg species of

Sublithacoceras, or of a Somaliland specimen of *Pseudovirgatites* I figured on a previous occasion (Spath, 1925: 136, text-fig. 4).

Phanerostephanus dalmasiformis sp. nov.

Plate 8, fig. 7

This form, unfortunately, is represented only by crushed examples including the type here figured, but apart from the whorl-thickness and the suture-line they show most of the external characters that make this species an interesting link between the genotype, *P. subsenex*, and *P. intermedius* on the one hand and the more specialized *P. hudsoni* on the other. The inner whorls show the fine ribbing and periodic constrictions of *P. intermedius*, but only to a diameter of about 25 mm. Then the costation becomes irregular and faint, except at the umbilical edge. On the outer whorl the ribbing has almost disappeared, on the side as well as the venter, while even the umbilical nodes become less distinct. There are two faintly prorsiradiate constrictions visible on the outer whorl, bordered by ribs on the periphery; the side is entirely smooth and was probably originally evenly rounded, not so flat as it now appears. The diameter is approximately 60 mm., unless the whorl-section was as inflated as in *P. hudsoni*; but there is the umbilical border of at least another quarter of a whorl.

The resemblance of the present form to certain species of *Dalmasiceras* is superficial, for the inner whorls are Perisphinctid, not Hoplitid, i.e. the ventral ribbing is not interrupted by a median groove or even a smooth zone. There may be more affinity with *Sublithacoceras glabrum* Schneid sp. (1915*a*: 337, pl. xxii, fig. 1), but the two forms are difficult to compare, not only on account of the difference in size, but also because of the defective preservation. *P. intermedius* sp. nov. (Plate 8, fig. 3) retains its costation to a much larger stage and shows fine peripheral ribs on the body-chamber still at 75 mm. diameter. In *P. subsenex*, at that stage, the venter is also already smooth, although the Perisphinctid aspect is retained to a much larger size than in the present form.

Genus ***NANNOSTEPHANUS*** gen. nov.

Genotype: *N. subcornutus* sp. nov. (Plate 10, fig. 7).

Diagnosis: Micromorph Perisphinctid derivatives in which the point of bifurcation of the ribs on the ventro-lateral edge is tuberculate. But degeneration soon sets in, the concave periphery becomes arched, the horns disappear, and the ventral ribs near the aperture are strongly projected, as in *Proniceras*. The suture-line is not clearly seen in any example, but is very simple.

The innermost whorls are finely ribbed, as in the *colubrini* and other Perisphinctids, and rather depressed, with a broad venter which soon becomes flat and then concave. The secondary ribs on the periphery may zigzag from side to side at this stage, but later ventral projection appears. Since all the twenty examples known of the typical species are of about the same size and since some show a complete aperture and modified ornamentation on the body-chamber, it is clear that they are fully grown ammonites.

REMARKS: Since the genera *Aulacosphinctes*, *Micracanthoceras*, and *Corongoceras* have been included in Himalayitinae, it might be thought that *Nannostephanus* is an early member of the same sub-family, though in the more typical Himalayitids the tubercles persist to much later stages. But the absence of a ventral furrow seems to show that the new genus is still closer to the Perisphinctid root-stock than to the later derivatives above mentioned.

The true *Aulacosphinctes* (restricted to the *mörickeanus* group), on account of its deep median furrow on the periphery, does not show zigzagging of the ventral ribs which occurs in the present genus. *Micracanthoceras* and *Corongoceras* seem more like *Nannostephanus*, but only superficially, being far more advanced, and the later stages are scarcely more comparable than the young. Certain forms of *Himalayites*, e.g. *H. cortazari* (Kilian), that have no ventral sulcus and thus are probably less advanced than the commoner types of the group of *H. seideli* (Oppel), are also quite different from *Nannostephanus*, in the young as well as the adult.

When I first saw these small ammonites, I was impressed by the fact that together with *Cochlocrioceras turriculatum* sp. nov. they were the commonest fossils in the fauna here described. But I took them to be inner whorls of some larger genus, like *Windhauseniceras* Leanza, 1945. The outer whorls, in that genus, however, return to a Perisphinctid aspect so different from the early tuberculate stage that Leanza even compared his genus to *Subplanites* and other, earlier, Perisphinctids. Unfortunately there is no material for dissection, but in any case the Argentine example of *W.* cf. *internispinosum* (Krantz) figured by Leanza (1945: 23, pl. xxi, fig. 6) is too badly preserved to be compared with the small forms here described. '*Aulacosphinctes*' *windhauseni* Weaver (1931: 412, pl. 44, fig. 300) retains the *Crendonites* aspect to a considerable diameter, but its inner whorls, to judge by the description, are apparently similar to the specimens of *Nannostephanus* in the present fauna.

There is nothing in the collections before me that could represent an outer whorl of *Windhauseniceras*. In fact there is only the *Aulacosphinctes*-like micromorph form described below as *Nannostephanus* sp. ind. (Plate 6, fig. 12) which is probably related to the typical *N. subcornutus*; but it is interesting to note that the only other ammonites here dealt with, having any resemblance to *Nannostephanus*, are *Proniceras* sp. nov. ? ind. (Plate 10, fig. 6) and the immature whorls of a transitional form attached to *Nothostephanus* (Plate 7, fig. 8). It is not believed that there is a close connexion between these genera, except a common Perisphinctid ancestry, but being a micromorph and transitional to *Phanerostephanus* as well as to *Nothostephanus*, the present genus is not easy to place.

According to Weaver (1931: 420) *Windhauseniceras internispinosum* occurs at the base of the Upper Tithonian, though on p. 46 he has a zone of *W. internispinosum* as the equivalent of the whole of that sub-stage. Leanza (1945) also had the same zone at the base of his Upper Tithonian. In view of the occurrence of *Nannostephanus* together with *Pseudolissoceras* (of the top of the Middle Tithonian ?) it seems clear that the present genus is not a micromorph derivative of *Windhauseniceras*.

The genus *Dickersonia* Imlay, 1942, somewhat resembles *Nannostephanus*, but it also returns to a perisphinctoid outer whorl, after an early spinose stage. The latter, however, as in the nearly allied *Corongoceras*, has peripheral as well as lateral tubercles.

Examples of *Dickersonia* of the size of the specimens here described are thus entirely different and the genus is much closer to the Himalayitinae than is *Nannostephanus*.

Nannostephanus subcornutus sp. nov.

Plate 10, figs. 7–10

The best of the twenty specimens available is that figured in Plate 10, fig. 7, and there is only one impression of a somewhat doubtful, larger example of about 25 mm. diameter which is represented in fig. 8 (from a plasticine squeeze). The most conspicuous feature of the new form is the sharp spine at the ventral edge on the ribs of the inner whorls, where they branch into secondaries that run across the flat and wide periphery with a slight median sinus directed forwards. The peripheral spine (or horn, where well preserved) is lost already at about 17 mm. diameter when the venter becomes arched rather than concave. Though the larger cast does not show the whorl-shape, the ribs seem to pass across an arched venter without a conspicuous peripheral shoulder.

At a diameter of 4 mm. the shell, at first smooth, is finely ribbed, there being about twelve primary ribs on the last half-whorl to eighteen secondaries. The venter at this '*celsus*'-stage is broad and widely arched; the very depressed whorl-section (thickness = 56 per cent.) just begins to show a ventral edge. The spines at this edge then gradually increase to a maximum at 12–15 mm. diameter, but often seem more prominent when seen in the umbilicus, because when exposed and viewed ventrally, they may appear to be merely sharp ribs, unless they are very well preserved. They then may be actual horns, projecting sideways as well as upwards. The secondary branches of the ribs on the slightly concave venter pass irregularly from side to side and occasionally join up with a single rib on the opposite side to form a zigzag pattern.

Something like this is shown, in a less extreme form, on the periphery of *Windhauseniceras internispinosum* Krantz sp. (1926: 453, pl. xiv, figs. 1–2; 1928: 39, pl. ii, figs. 3–4), though owing to its larger size and the presence of trifid ribs, with the spines moved down to almost the middle of the whorl-side, the ventral aspect is different. In the present form, when the venter has become arched, there may also appear (at least in the doubtful cast, fig. 8) trifid ribs and even one quadrifid primary, succeeded by a single costa and a trifid rib, but the point of branching is no longer prominent.

Nannostephanus sp. ind.

Plate 6, fig. 12; Plate 8, fig. 5

The specimen here figured is very poorly preserved, but it is interpreted as a development of the same dwarf-stock that also produced *Nannostephanus subcornutus*, a stock that may be connected with the more orthodox '*Aulacosphinctes*' *colubrinoides* Burckhardt sp. (1903: 57, pl. x, figs. 9–11) from the Middle Tithonian of Argentina. The '*colubrinoides*'-stage, however, in the present form persists to only about 18 mm. diameter, presumably the end of the septate portion of the ammonite. Later the point of bifurcation of the ribs moves lower down the whorl-side, the ribs are more closely spaced, more inclined, and actually crowded near the aperture. At the same time the ventral sinus of the ribs, directed forwards, becomes pronounced on the body-chamber until, near the ventral lappet of the mouth-border, the peripheral projection is as extreme as in *Proniceras*. There is no trace of a siphonal interruption of the ribs, as in somewhat similar young *Micracanthoceras*. The suture-line is not exposed and the body-chamber is assumed to occupy the last half-whorl only because the aperture is intact, at least ventrally.

I was at first inclined to refer the present form to *Aulacosphinctes*, not because it belongs to the *mörickeanus* group to which the genus was previously restricted, but because forms of the *colubrinoides* type have also been included in that genus, or even in *Crendonites* Buckman (see Spath, 1925: 145; 1936: 31). Moreover, there is a certain resemblance to the earlier *A. colubrinus* (*non* Reinecke) figured by Steuer (1897: 62, pl. xxix, fig. 11). This also has the ribbing continuous across the periphery, at least on the outer whorl; as it otherwise agrees with the typical *Aulacosphinctes* much more than does *A. colubrinoides*, it could be considered a forerunner of the Upper Tithonian species of the *mörickeanus* group. *A. colubrinoides*, according to Burckhardt (1930: table xi), comes from above the zone of *Pseudolissoceras zitteli*, so that Steuer's form which comes from below may not have a sulcate periphery, even in the young. *A. pseudocolubrinus* (Kilian), in which species Blanchet (1928) included both Steuer's *A. colubrinus* and Zittel's Rogoznik form (1870: pl. x, fig. 6), also has the merest suspicion of a ventral furrow in the young, but I have not seen the illustration of any example of these forms with the change in ribbing near the mouth-border which is characteristic of the present example. It is thus much more probable that the latter belongs to the micromorph stock here separated as *Nannostephanus* and that the absence of spines at the point of branching of the ribs on the earlier whorls is only due to the bad preservation.

A somewhat doubtful second specimen (No. C.41129), unfortunately only 11 mm. in diameter, is figured in Plate 8, figs. 5*a–c*. The thickness is considerably greater than the whorl-height throughout; but the venter is evenly arched and appears to be flat, as in the young *N. subcornutus*, only at the beginning of the last whorl. At the same time the point of bifurcation of the ribs at the ventral edge is projecting sideways, though not actually cornute, and the resemblance to the young of the form just cited is not very close. In '*Aulacosphinctes*' *kossmati* Uhlig (1910: pl. xxxvii, fig. 3) the projecting point of bifurcation of the ribs is retained on the outer whorls, but the venter is then still more rounded. In young *Aulacosphinctoides* from the Spiti Shales and the *Virgatosphinctes* Marls of Andranosamonta, Antsalova, &c. (Madagascar), the point of bifurcation of the ribs is prominent, but the venter is rounded even on the innermost whorls. These, however, are all sulcate in the siphonal line, unlike the present form. It is possible that this second example is the young of a more Aulacosphinctoid form.

Sub-Family Virgatitinae Spath

This sub-family (at first, 1925, proposed as a family) is now used in its original connotation; for the sub-family 'Pseudovirgatitinae', separated from it in 1931, was based on the genus *Pseudovirgatites* Vetters, and there is some doubt about the affinities and the range of that genus. I had previously considered the genotype *P. scruposus* (Oppel) from the Klentnitz Beds of Niederfellabrunn to be related to *Pectinatites* Buckman, from the Upper Kimmeridge Clay, implying that its inclusion in the Stramberg fauna was due to some error, perhaps a deceptive similarity of matrix. I am certainly at a loss to account for the extraordinary resemblance, even in suture-line, of the 'Tithonian' *P. seorsus* (Oppel) and the 'Volgian' *P. quenstedti* (Michalski) to *Pectinatites aulacophorus* Buckman, from the Upper Kimmeridge Clay, unless they are related. In other words, *Pectinatites* may be a synonym of *Pseudovirgatites*.

On the other hand, Burckhardt (1930) recorded *P. scruposus* from the beds with *Substeueroceras multicostatum*, his highest zone in the Tithonian, and since this would make the range of that species abnormally long, even if my interpretation of the Tithonian (p. 131) be rejected, it may be suggested that there is a later Jurassic stock, homoeomorphous with the Kimmeridgian *Pectinatites* (or *Pseudovirgatites*?). Leanza (1945) indeed confirmed this in referring to *Pectinatites* (with a query) the Upper Tithonian *Reineckeia striolata* Steuer; and another form with resemblance to the species of *Pectinatites* above cited is Steuer's *Perisphinctes densistriatus* (1897: 62, pl. xv, figs. 8–10). In any case, the genus *Pseudovirgatites* and therefore the sub-family Pseudovirgatitinae remain of uncertain standing.

Finely ribbed Perisphinctids, of course, were developed repeatedly, from the Middle Kimmeridgian *Lithacoceras* (*ulmensis* group) up to the Tithonian *Sublithacoceras* (*senex* group), and I mentioned before that if *Pseudovirgatites* itself should be less closely allied to *Pectinatites* than I thought, a different grouping might become necessary. But I am not in a position to suggest more than a few minor changes in the classification of the incompletely known Perisphinctids of the late Jurassic. Thus, while adding one more to the genera previously (1931: 468, 1936: 18) recognized in the sub-family 'Pseudovirgatitinae', I may point out that the young of *Pectinatites* are as different from the Tithonian forms here described as they are from the immature true *Virgatites* or the closely allied *Zaraïskites*. The Kimmeridgian *Pectinatites*, in fact, may well be left in the parent-stock, Virgatosphinctinae, for it is probably a development of its immediate forerunner, *Subplanites* which includes some of the prolific '*contiguus*' group.

As regards the other genera of the former sub-family 'Pseudovirgatitinae', the genus *Anavirgatites* Spath is closely related to what I had considered to be typical *Pseudovirgatites*, i.e. the Upper Tithonian elements, and though they are not boreal types, they may well be classed with the Virgatitinae. The genus *Parapallasiceras* Spath, based on *P. praecox* Schneid sp., ranges from 'Pseudovirgatitid' forms like *P. ciliatum* Schneid sp. to other species of '*Berriasella*' described by that author which have decided leanings towards *Pallasiceras* and the Pavlovinae. I do not consider that this group of '*Berriasella*' *praecox* has close connexion with the Berriasellidae, the forerunners of the Neocomitidae, except of course a common derivation from a Perisphinctoid root. The less modified forms of the '*ciliata* group' are indeed close to the '*colubrini*' which persisted more or less unchanged throughout the Upper Jurassic and gave rise to the Pavlovinae as well as to the true *Aulacosphinctes*. Schneid himself stated that he was inclined to look upon his forms of '*Berriasella*' rather as Perisphinctids than as Hoplitids, whereas Mazenot (1939) identified with Schneid's species Upper Tithonian and even Cretaceous (Berriasian) forms that may be true Berriasellids but, to me, bear no close resemblance to the Neuburg types.

Apart from the genera *Pseudovirgatites*, *Anavirgatites*, *Parapallasiceras*, and *Sublithacoceras*, so far mentioned, the Virgatitinae also include *Pseudinvoluticeras* Spath, and in view of what is said below (p. 115) about the close affinity between that genus and *Nothostephanus* gen. nov., the latter similarly is now referred to the same sub-family. *Nothostephanus* is connected by intermediaries with the new genus *Phanerostephanus* discussed above, although an extreme form of that genus (*P. hudsoni*) seems far removed from either Virgatosphinctinae or Virgatitinae. *Phanerostephanus* is now included in the former sub-family, but as the more typical species like *P. subsenex* also resemble *Sublithacoceras* (*senex* group) and retain the Perisphinctid aspect only to a comparatively small diameter, *Phanerostephanus* could perhaps equally well have been included here. The transitions between that genus and *Nothostephanus*, unfortunately, are represented only by crushed impressions but appear to comprise at least two distinct species. One (C.41167, 41182) is a more evolute edition of *N. kurdistanensis* with Perisphinctid, not Virgatitid inner whorls. That is to say, there are more numerous volutions at a given diameter, with the umbilical width increased to about 33 to 35 per cent. (instead of 22 per cent.) and the umbilical wall low and not sharply defined (compare the inner whorls of Plate 7, figs. 1–3, with those of fig. 6). The second transition has already been referred to under *Phanerostephanus subsenex* (p. 105).

Umbilical tubercles, developed in *Pseudinvoluticeras*, *Nothostephanus*, and *Phanerostephanus*, and only just indicated in *Sublithacoceras*, are really more characteristic of Olcostephanidae than of either Virgatitinae or Virgatosphinctinae. The classification of the transitional types here adopted is thus not entirely satisfactory; but to link these typically Jurassic forms with the essentially Cretaceous *Dalmasiceras* or any other Berriasellid would be still less acceptable.

Genus ***NOTHOSTEPHANUS*** gen. nov.

Genotype: *N. kurdistanensis* sp. nov. (Plate 7, figs. 1–4).

Diagnosis: Fairly involute platycones with high whorls, narrowly rounded venter, and flat sides. Greatest thickness at umbilical nodes on edge of high and steep umbilical slope. Innermost whorls to about 7 mm. diameter rather evolute, with whorls as wide as they are high and simple, distant costation, consisting of single and bifurcating ribs, almost as in *Nannostephanus* (p. 109). One specimen (Plate 7, fig. 8) indeed is transitional to that genus, but at 13 mm. diameter it assumes the typical aspect of the other young specimens (figs. 3, 4), so far as can be seen. At this stage the whorls flatten, the umbilicus narrows, and the ribs become more closely spaced and show irregular branches, with the anterior or posterior branch of the trifid ribs coming off rather low on the whorl-side as in true *Virgatites*. At 30 mm. the ribbing begins to weaken laterally and it becomes difficult to distinguish the branches from merely intercalated secondaries. The ventral sinus, directed forwards, is prominent and there is no sign of a siphonal flattening or interruption of the costation. At 50 mm. diameter the crescentic umbilical portion of the primary ribs is distinctly raised, though true inner nodes are not developed until a diameter of 90 mm. is reached. The secondary ribs then seem to disappear and on the body-chamber probably only the blunt and rounded umbilical tubercles remain. There are indistinct constrictions at irregular intervals; there may be three or four on some of the younger examples, but the holotype only shows one at the beginning of the outer whorl and a very faint constriction, preceded by a raised rib, about half a whorl farther on. In one impression the position of the aperture is marked by a strong constriction, but its ventral portion is not preserved.

The suture-line is characterized by a broad, bifid external saddle, a trifid lateral lobe, about as deep as the external lobe, and two more saddles on the whorl-side which are considerably more slender than those of the simplifying last suture-line shown in fig. 1*a*. The auxiliaries beyond the umbilical tubercle are not visible, but the suture-line as a whole is only slightly pendent towards the umbilicus.

REMARKS: When I first saw the ammonite here described as the holotype of *N. kurdistanensis*, I was struck by its resemblance to *Odontoceras anglicum* Steuer (1897: 165, pl. xxx, figs. 15–17), but that species is a Lower Kimmeridgian *Aulacostephanus* and there could be no real affinity, apart from a common ancestry in a Perisphinctid root-stock. When many years later I examined numerous young examples of the same species, it became clear that the development was entirely different in the two stocks and that there was equally little in common with another superficially similar group, namely, that of *Amm. occitanicus* Pictet (1867: 81, pl. xvi, fig. 1; 1868: 248, pl. 39, fig. 1). This form, which I previously (1939*a*: 62) described as an involute development of *Subthurmannia boissieri* (Pictet) but which Mazenot (1939) included in *Neocomites*, differs from the genus here discussed not only in its ventral groove, which persists to a comparatively late stage, but especially in its suture-line. In *Nothostephanus* this is simplified at the end, but before that it is about as complex as the suture-line of *Dalmasiceras dalmasi* Pictet sp. (in Djanélidzé, 1922: 267, text-fig. 3), only this has a much deeper lateral lobe. *Nothostephanus*, moreover, has constrictions; the ribbing is continuous across the venter even in the earliest stages, and if *Amm. progenitor* Oppel (in Zittel, 1868: 99, pl. xviii, figs. 3*a*–*d*) is a Tithonian forerunner of *D. dalmasi* of the Berriasian (Mazenot, 1939: 144), then the new genus here described is entirely distinct from *Dalmasiceras*.

There is probably greater affinity of the present genus with *Pseudinvoluticeras* than with any other described forms, especially since the suture-line of *P. somalicum* Spath (1925: 142, text-fig. 10) is very similar to that of *N. kurdistanensis*, before simplification sets in. *P. decipiens* Spath (= '*Simbirskites*' *payeri* R. Douvillé, *non* Toula, 1910: 18, pl. xix, fig. 3) is closer to the present form than either *P. somalicum*, the genotype, or *P. douvillei* Spath, and although its whorl-section still shows the inflated shape characteristic of '*Holcodiscus*' *wilfridi* R. Douvillé and the other two species of *Pseudinvoluticeras*, the lateral aspect is similar. A form that may be identical with *Pseudinvoluticeras douvillei* was described by Weaver (1931) as *Virgatosphinctes lotenoensis* Weaver and referred to the Lower Tithonian; but its near ally *V. windhauseni* Weaver (1931: 425, pl. 48, figs. 324–5) may also be related to the genus *Nothostephanus* and being Middle Tithonian (zone of *Pseudolissoceras zitteli*) is probably of about the same age.

It is believed that the compression, resulting in a narrow periphery in the present form as in the true *Virgatites virgatus* (v. Buch), is responsible for the pronounced ventral sinus of the ribbing. The presence of constrictions, as in *Pseudovirgatites*, enhances the similarity between *Pseudinvoluticeras* and the genus here discussed. If the latter, however, be connected by real transitions with *Nannostephanus* (Plate 7, fig. 7), the position of *Nothostephanus* within the Virgatitinae is somewhat doubtful, though this may indicate no more than derivation of both genera from a Pavlovid ('*colubrinus*') stock.

Nothostephanus kurdistanensis sp. nov.

PLATE 7, FIGS. 1–4, 8

The holotype of this form (fig. 1) has the following dimensions:

Diameter . . .	90 mm.
Height of the last whorl	47% of the diameter
Thickness of the last whorl	27% ,, ,,
Width of the umbilicus .	22% ,, ,,

Since the generic diagnosis given above is based on the present species, there is little to add here, except that the small portion of body-chamber shown in fig. 1*a* is crushed. Assuming the complete body-chamber to have occupied at least another half-whorl, the total diameter of the shell must have been about 130 mm. There are at least another thirty examples of this form, but they are mostly crushed impressions except for some inner whorls, forming a solid core to the impressions. There are slight differences in the closeness of the ribbing (compare figs. 2, 3), but these are trivial. The immature original of fig. 4 (enlarged ×2) has the typical costation from the start. Another similar young individual (fig. 8), however, retains the biplicate stage, with ventro-lateral spines, to a larger diameter than the typical specimens and at first sight might be taken to belong even to a different genus. It is probably a transition to the form described above as *Nannostephanus subcornutus*. Nothing like this change in ribbing is seen on the inner whorls of *Virgatites* or *Zaraïskites* before me, although at about 20–30 mm. diameter they may be very similar to the present form (e.g. fig. 2).

There is a certain resemblance between the outer whorl of *Nothostephanus kurdistanensis* and that of *Proniceras jimulcense* Imlay from the *Substeueroceras* beds of Mexico (1939: 55, pl. xviii, figs. 1–3), a form that almost looks like a less involute development of the same stock. But the resemblance is believed to be entirely superficial and confined to the outer whorls. The direction of the constrictions alone is sufficient to distinguish the two stocks and the typical *Proniceras* early whorls of the Mexican form confirm the fundamental difference. The derivation of the Tithonian *Proniceras* from the Lower Kimmeridgian *Idoceras* (Burckhardt, 1921, and Djanélidzé, 1922*a*) is based on a similar superficial resemblance.

Four examples in the collection, varying from 15 to 50 mm. in diameter, might be considered to belong to a finely ribbed variety of the present species. They have the small umbilicus of *Nothostephanus*, but unfortunately they are all crushed so as to resemble *Kossmatia* in the outer whorl. Only the primary ribs in all these forms are quite different from those of *K. richteri* Oppel sp. (see Mazenot, 1939: pl. xxi, fig. 4); nor can they be taken to be transitions to *Phanerostephanus*, for the inner whorls are merely young *N. kurdistanensis*, more densely ribbed than the original of Plate 7, fig. 2.

Family OLCOSTEPHANIDAE Kilian, emend. Spath, 1924

Sub-family SPITICERATINAE Spath, 1925

Genus *PRONICERAS* Burckhardt, 1919

Proniceras garaense sp. nov.

PLATE 10, FIGS. 1–3

As holotype of this new species may be taken the example (No. C.40742) figured in Plate 10, figs. 1*a*, *b*, which has the following proportions:

Diameter . . .	59 mm.
Height of last whorl .	25% of the diameter
Thickness of last whorl .	25% ,, ,,
Width of umbilicus .	54% ,, ,,

The whorl-section is almost galeate, as in some *Spiticeras* or in *P. pronum* Oppel sp. (in Zittel, 1868: pl. xv, fig. 8), owing to the high umbilical slope and the small yet distinctly elevated tubercles at the edges. But the early Perisphinctoid whorls are more rounded and the innermost volutions are even depressed, as in the less slowly coiled young *P. toucasi* Retowski sp. figured by Djanélidzé (1922*a*: 64, pl. ii, figs. 1*a*, *b*). The ribbing is similar to that of the form just cited to a diameter of 23 mm. where there is a constriction. The number of these constrictions on the inner whorls is first three then four, but on the outer whorl, which is all body-chamber, there are five. They are greatly projected on the periphery and truncate four or five ribs, the last of which forms an acute chevron on the venter. There is a very long terminal rostrum, projecting 16 mm. beyond the anterior edge of the final constriction.

After the constriction at 33 mm. diameter the primary ribs which seem to be gradually becoming more distantly spaced are developing umbilical swellings. These are conspicuous in the peripheral view but are not actual spines. The ventral sulcus is distinct at the beginning of the outer whorl but then disappears.

The last two suture-lines are visible just before the fracture at the beginning of the outer whorl and they differ from those figured by Djanélidzé (1922) in having the lateral saddle as broad as the external. In their simple outline the elements are comparable to those of the suture-line of *P. minimum* (Jacob MS.) Djanélidzé (1922*a*: 81, text-fig. 15), but the wide, bifid lateral saddle of the present form is at least as indented as the external saddle of *P. minimum*. The short and high second lateral lobe is already at the umbilical tubercle and there is only one more comparatively broad, second lateral saddle on the umbilical slope. It is not impossible that the last suture-lines owe their simplicity to reduction, observed in the final septal edges of many adult ammonites.

A smaller paratype (Plate 10, fig. 2) retains the depressed inner whorls to a later stage than the holotype, so that the whorl-thickness is greater than the height even just before the end of the outer whorl. The aperture is intact, though the ventral lappet is broken off and it is slightly crushed. In spite of various slight differences, however, such as the more clearly marked furrow on the venter of the first half of the outer whorl, this second example and the holotype evidently belong to the same species. The whole of the outer whorl appears to be body-chamber, but the suture-lines could not be exposed.

A third and still smaller example, figured in Plate 10, fig. 3, at first sight also looks like an inflated variety of the present species since its whorl-thickness (36 per cent. at 37 mm. diameter) exceeds the whorl-height (30 per cent.) and since it has a smaller umbilicus (48 per cent.). But apart from the faintness of the ribbing which may be due entirely to slight corrosion, this third example is really indistinguishable from the inner whorls of the holotype at the same size. Unfortunately the suture-line is not visible and the black, bituminous test together with the brown crystalline calcite-matrix does not yield to treatment with acid; but the example seems to be entirely septate.

The periphery of a large fourth example (No. C.41052) with two constrictions has no ventral sulcus. It is only a fragment of a body-chamber, too incomplete to be figured, but it shows that the holotype does not represent the maximum in size. The costation is still regular at what appears to be the apertural end (the second constriction), whereas in both holotype and paratype the ribbing is rather irregular towards the end of the shell.

This species is close to *P. subpronum* Burckhardt (1919–21: 48, pl. xvi, figs. 9–15, &c.), especially to the original of figs. 9–11, but it has a distinctly wider umbilicus and more oblique constrictions. The ventral chevrons of the present form are thus considerably more acute than those of any of the Mexican species of *Proniceras* figured by Burckhardt, or, indeed, of the European forms described by Djanélidzé.

Proniceras simile sp. nov.

PLATE 10, FIGS. 4, 5

This form was at first taken to be only a compressed variety of *P. garaense*, but it differs not only in dimensions but in various other features, notably the suture-line, so that it is now described as an independent species. The holotype (No. C.41053) figured in Plate 10, fig. 4, has the following dimensions:

Diameter . . .	40 mm.
Height of last whorl	30% of diameter
Thickness of last whorl	24% ,, ,,
Width of umbilicus .	51% ,, ,,

The whorl-section is ovate, with flattened sides and an evenly rounded venter. The Perisphinctoid stage is far less pronounced than in *P. garaense*. The innermost whorls are almost smooth to a diameter of approximately 6 mm. and the very strongly projected ribbing remains faint to about 15 mm. After that the primary costae are slightly more distantly spaced but the curvature becomes crescentic (projected at the umbilical end as well as on the periphery). The umbilical nodes are not conspicuous until after the constriction about a quarter of a whorl from the present end of the specimen which itself is at a constriction, the fifth on the outer whorl (entirely septate). The suture-line has a simple trifid lateral lobe and a small lateral saddle, unlike the corresponding element in *P. garaense*. The simple second lateral saddle, as in *P. minimum* (Jacob MS.), above cited, is already on the umbilical slope.

The smaller example figured in Plate 10, fig. 5, is curiously malformed in having a peripheral hump comparable to, but much smaller than, that of *Oecoptychius refractus* (Reinecke). This hump is situated half-way between two constrictions and appears to be perfectly symmetrical when viewed ventrally; but slight displacement of the lateral ribbing suggests that it was due to an injury and therefore pathological.

A large specimen of perhaps 70 mm. diameter has the outer whorl (body-chamber) crushed and appears to be almost smooth; the indistinct umbilical nodes, however, and the secondary ribs of the venter are still visible, in spite of the flattening. Apart from the fact that the peripheral ribs are far more oblique, this large example shows considerable resemblance to *P. neohispanicum* Burckhardt, or at least to the outer whorls of the two specimens figured by that author (1921: pl. xv, figs. 1, 5–7). The 'Idoceratid' inner whorls of the Mexican species, on the other hand, are quite different from those of the form here described.

P. minimum (Jacob MS.) Djanélidzé, already referred to, has faint ribbing, like the present species, but not on the earlier, Perisphinctoid whorls. Its constrictions are also far less oblique and the whorl-section is more rounded.

Proniceras sp. nov.? ind.

PLATE 10, FIGS. 6*a*, *b*

One apparently new form, represented only by a single specimen, is more coarsely ribbed than the two species described above, and there are no single ribs as in *P. pronum* itself. At least, Zittel's original smaller figures (1868: pl. xv, figs. 9*a–c*, 11*a*, *b*) are no more comparable to the present form than is the lectotype (fig. 8) or the large example (fig. 10) which was excluded from *P. pronum* already by Djanélidzé. On the other hand, one of the fragments included by the latter author in *P. toucasi* (Retowski) var. *dorsosulcata* Djanélidzé (1922*a*: pl. iv, figs. 3*a*, *b*) has similar ribbing, at least on the venter, with its slight, median groove; but the inner whorls of figs. 1 and 2 of the same variety are still much too finely costate.

In the present form the ribs are irregularly bifurcate and trifurcate and almost straight, although the four constrictions are very oblique. On the very broad venter all the secondary ribs have a median sinus, pointing forwards, and there is no suspicion of a tubercle at the point of bifurcation, as in the somewhat similar young forms described above as *Nannostephanus*.

On account of the coarseness of the ribbing and the distinctive appearance of the present form, so different from the typical Mexican species of *Proniceras*, it might even be doubted whether it is correctly interpreted as the inner whorls of a *Proniceras*. The suture-line is not visible, but since the last fifth of the outer whorl is crushed and apparently formed part of the body-chamber, the shell must have been larger than about 33 mm. diameter. The peripheral aspect and the oblique constrictions certainly suggest reference to *Proniceras*. But the general '*colubrinus*'-habit indicates perhaps where the typical *Proniceras* ancestor is to be found. It would also explain the curious resemblance to those transitions between *Nothostephanus* and *Nannostephanus*, referred to on p. 114.

Family PROTANCYLOCERATIDAE Breistroffer, 1947

This family at present includes only the type-genus itself, here represented by the typical *P. kurdistanense*; a new genus of which the genotype, *Cochlocrioceras turriculatum* nov., is described below; and the genus *Bochianites* P. Lory, 1898. There is probably another new genus mentioned above (p. 97) from a bed in the Jebel Gara sequence which is still of Tithonian age. The forms so far described have been referred to such diverse groups as *Crioceras*, *Aegocrioceras*, *Leptoceras*, *Ancyloceras*, *Ptychoceras*, and *Hamites*, while Stoliczka's *Anisoceras gerardi* was redescribed by Uhlig as a form of *Bochianites*. There are thus probably still other genera to be separated in the present family, as and when the forms become known in more detail. But they are clearly not connected with the Neocomian family Crioceratidae, as I understand it. The latter probably originated independently in the Lytoceratidae, whereas Protancyloceratidae were hitherto presumed to be indirect descendants of a Perisphinctoid stock.

As the most probable parent-family of *Protancyloceras* itself I designated the Simoceratidae (Spath, 1939: 581). They are not only the immediate forerunners of *Protancyloceras* in time, being Lower Tithonian, whereas the present family first appeared in the Middle Tithonian, but they include a number of polygyral types such as have repeatedly given rise to uncoiled stocks. In 1925, however, I had already suggested that at least one Simoceratid, namely, *Lytogyroceras* (= group of *Simoceras lytogyrus* Zittel), had a Lytoceratid origin. The costation first appearing on the inner whorls instead of the outer, it had been assumed that *Lytogyroceras* was derived from the Perisphinctidae. Likewise the uncoiling would have affected first the unstable early whorls, following on the protoconch and the first volution (to at least the initial constriction) which rarely uncoils (Plate 8, fig. 4). Now it does not seem to me a coincidence that the long-lived *Protetragonites*, the presumed ancestor of *Lytogyroceras*, was one of the commonest ammonites throughout the Tithonian when Protancyloceratidae arose. There is a close parallel to this appearance of uncoiled derivatives in the Upper Bajocian, where *Spiroceras* and its allies were (probably in error) believed to have resulted from the uncoiling of some polygyral member of the family Parkinsonidae. The astonishing abundance of another Lytoceratid (*Polystomiceras tripartitum* Raspail sp.) during the Parkinsonian age in the Mediterranean area suggests that *Spiroceras* also had a Lytoceratid origin, which indeed has long been accepted for nearly all the numerous heteromorphs of the Cretaceous. The appearance of ribbing in the offshoots of the originally smooth Lytoceratidae would be connected with the change in the mode of life and the ornamentation in its turn may have affected the suture-line.

There are, however, certain exceptions; for example, the genus *Distoloceras* Hyatt is referred to the family Neocomitidae, in spite of the uncoiling of some species. I should also add that one of the new, uncoiled species from the higher beds of Jebel Gara, referred to on p. 97, seems to be connected with the associated Berriasellidae and is apparently not a derivative of *Protancyloceras*. It will, of course, have to be excluded from the present family.

The sub-family Bochianitinae Spath, 1922, is now taken to include the straight end-forms of Protancyloceratidae. I formerly had them as a sub-family in Berriasellidae and Neocomitidae (*not* Parahoplitidae, as Mazenot states); but in 1930 (p. 155) already I suspected the possible connexion of *Bochianites* with the Tithonian genus *Protancyloceras*. The Spiti Shales *Bochianites gerardi*, already mentioned, is one of the transitional forms.

When describing the fauna of the Viñales Limestone of Cuba, R. W. Imlay (1942) was struck with the richness in form and number of uncoiled ammonites which contrasted markedly with the scarcity of such heteromorphs in Tithonian deposits of other parts of the world. Imlay, however, considered the family relationship of his uncoiled ammonites as highly uncertain and he provisionally referred them partly to *Leptoceras*? (family Ancyloceratidae) and partly to *Hamulina*? and *Ptychoceras*? (family Lytoceratidae). The resemblance in shape of the Cuban forms to the Cretaceous genera just mentioned is almost certainly fortuitous and the two species described as *Leptoceras*? *catalinense* and *L.*? *hondense* Imlay are in my opinion typical *Protancyloceras*, comparable to some forms described below as *P.* aff. *gracile* (Oppel) and with similar initial whorls. *Hamulina*? *rosariensis* Imlay probably also falls within *Protancyloceras*, in spite of its final crozier, but whether *Ptychoceras* (?) sp. represents a modification sufficiently distinct for generic separation it is impossible to say in the present state of our knowledge.

Genus *PROTANCYLOCERAS* Spath, 1924

Protancyloceras kurdistanense sp. nov.

PLATE 9, FIGS. 1–5

The holotype (fig. 1) consists of nearly three-quarters of a plane spiral, about half of which is body-chamber and the rest air-chambers. The last septal surface is shown at the fracture, immediately before the change in ornamentation sets in; but apart from the fact that the septal edge is perfectly symmetrical and the lobe-formula is ELUI, i.e. primitive, as in other uncoiled forms, the details of the suture-line could not be made out.

The early whorls are unknown. At the smaller end the holotype has a thickness of nearly 8 mm. where the height is 10 mm. and the whorl-section is oval, slightly wider on the dorsal side than on the ventral. There is a faint, smooth band along the median line of the periphery and a corresponding impressed dorsal area on the opposite side. Later, height and thickness become more nearly equal, and at the end they are both 20 mm. With the change in the ribbing the ventral band becomes a pronounced groove at the end and the dorsal impressed area has disappeared, at least on the test.

The ribbing at first is closely spaced, curved, and strongly inclined forwards, with the costae terminating at the side of the smooth ventral zone but connected across the sulcate dorsum by extremely fine striation. This is straight at first, but becomes increasingly projected forwards so that at the end the strong lateral ribs and the intervening fine lines of growth give rise to dorsal striation that has a flat but pronounced sinus directed forwards. The change in ribbing is already indicated by irregularities just before the last septum, but a few intermediate ribs remain at first on the body-chamber, and even the sixth rib from the end still shows an abortive attempt at splitting up into two. Apart from their general irregularity it is noticeable that the strong ribs are also becoming increasingly projected forwards at the dorsal end. The body-chamber is complete, but the aperture itself is damaged, at least on the figured side. The ventral lappet projects 10 mm. beyond the last rib shown and is evenly and rather narrowly rounded. The last few ribs are not so regularly opposite one another on the venter as the ribs on the earlier part of the body-chamber.

A second specimen (Plate 9, fig. 2), almost as complete as the holotype, has no peripheral groove and the costae of the septate stage are coarser and less closely spaced. These differences are not considered of specific importance, but two more body-chamber fragments (figs. 3, 4) also have no ventral sulcus. There are also two impressions of the finely ribbed septate stage, one of them figured in Plate 9, fig. 5; unfortunately it lacks the beginning of the shell. This was probably similar to the initial whorls described below under *P.* aff. *gracile* or to those of *Hamites* and possibly equally irregular (see Spath, 1939: 605).

There are two more fragments of septate whorls, corresponding to the chambered portion of the holotype, but these also do not show the suture-line.

The genotype of the genus *Protancyloceras*, namely, *P. guembeli* Oppel sp. (in Zittel, 1870: 115, pl. xii, figs. 1–2), is known only in two body-chamber fragments, one of them deformed; but it can be seen at once that the coarse ribs are distantly spaced, short and not curved, except at the beginning of the malformed smaller example. The agreement in the ventral sulcus, the lappet of the aperture, and the dorsal striation, however, makes it probable that the two species belong to the same group.

The *Crioceras* sp. ind. figured by Burckhardt (1919–1921: 58, pl. xxi, fig. 3) from beds with *Parodontoceras* (presumably at the base of the Berriasian) is somewhat like the chambered portion of the species under consideration, but it is too poorly preserved for more detailed comparison. The Mexican *Aegocrioceras* sp. figured by Imlay (1939: 57, pl. xi, figs. 1–2) has coarser and less inclined ribbing than the septate part of *P. kurdistanense*. It may well be a distinct species, and it is interesting because it was also associated with *Proniceras*, but in the *Substeueroceras* Beds.

Protancyloceras sp. aff. ***gracile*** (Oppel)

Plate 6, figs. 13, 14; Plate 8, fig. 4; Plate 9, figs. 6, 8

Cf. 1870. *Ancyloceras gracile* Oppel: Zittel, p. 115, pl. xii, fig. 3.

There are a number of examples of *Protancyloceras* with a general resemblance to Oppel's species, but it is possible that they belong to more than one form and that *P. catalinense* and *P. hondense* (Imlay) are among these. It is not certain, of course, that *P. gracile* had finely ribbed, open whorls in the young. Retowski's (1893: pl. xiv, fig. 5) small fragment, in any case, is not much like any Kurdistan example, and it is straight while still closely ribbed. If correctly interpreted, the Crimean form and Oppel's original must have formed part of much more open spirals, as nearly straight as the large shaft figured in Plate 9, fig. 6. But such changes in coiling need not be of fundamental importance.

The original of Plate 9, fig. 8, may be taken as a typical small fragment of the present form, but the isolated portions of the finely ribbed earlier half of the coil are scarcely visible in the photograph. It is possible to identify with this first example the two fragments of spirals represented in Plate 8, fig. 4. Associated with these on the same piece of limestone are the protoconch, initial whorl, and first part of the uncoiled stage of what is almost certainly the same form, though the slab also contains a fragment of the ubiquitous heteromorph described below as *Cochlocrioceras turriculatum* nov. This protoconch and early stage are missing in Plate 9, fig. 8, but if the original of Plate 9, fig. 6, really represents the final shaft of the same form as the other fragments just mentioned, the species would be fairly completely known as regards shape.

The ribbing in this first form is very gently curved, laterally, and it is distinctly projected ventrally, where it shows its maximum development, except for the pronounced siphonal interruption. It is weaker on the dorsal side, but continuous across, as in Oppel's species. The suture-line is not seen in any of the specimens, but presumably of the simple IULE pattern. Since the suture-line of *P. gracile* is also unknown, the comparison is limited to the external features.

The Jebel Gara specimens so far discussed and provisionally attached to *P. gracile* could also be compared with *P. hondense* Imlay (1942: pl. x, fig. 7). This seems to differ chiefly in its more rigid costation, less distinct ventral interruption of the ribs, and perhaps mode of coiling, though the last character is not here considered of even specific importance.

The originals of Plate 6, figs. 13, 14, and other specimens from a different locality are crushed and this may account for an apparently more rapid rate of increase of the spiral, compared with the solid whorls of the Jebel Gara specimens. The crushed examples just mentioned are more like Imlay's *P. catalinense* (1942: pl. x, fig. 4) with closer ribbing in the early stages and a different rate of increase from *P. hondense*. In view of the fragmentary state of the material available, however, it is not considered advisable to split the forms up into distinct species and I am provisionally attaching them all to the Mediterranean *P. gracile* rather than to Cuban forms that may turn out to be perhaps more distinct than the figures suggest.

Genus *COCHLOCRIOCERAS* gen. nov.

GENOTYPE: *C. turriculatum* sp. nov., Plate 8, fig. 8.

DIAGNOSIS: Protancyloceratid with helicoid or turrilitoid early whorls and Ancyloceratid body-chamber, the latter almost in one plane. Ribbing fine at first, but comparatively coarse and distant later, inclined forwards and curved, with a helicoid twist and distinct ventral interruption. Ribs tending to unite in ventral chevrons towards the aperture which is provided with a lappet, as in *Protancyloceras*. Suture-line unknown.

REMARKS: This genus is separated from *Protancyloceras* on the basis of coiling alone, scarcely sufficient in my opinion, though the helicoid twist in the ribbing is likely to have affected even the suture-line. The separation is, however, in conformity with the reference to very diverse but unrelated Cretaceous genera of the different Upper Jurassic uncoiled forms so far described.

The initial whorls (with the protoconch) of a heteromorph, figured in Plate 6, fig. 11, may belong to the present genus. They are associated on the same slab with a typical fragment of *C. turriculatum*, but the initial whorls do not differ from those of *Protancyloceras* (Plate 8, fig. 4) except that they just become uncoiled, without going off in a slender and elongated shaft. Definite identification is perhaps impossible, but it is probable that the earliest whorls in the two genera were similar until they lost contact and went off in different directions, those of the present genus opening out only slightly but becoming helicoid.

Cochlocrioceras turriculatum sp. nov.

PLATE 6, FIG. 11; PLATE 8, FIGS. 4, 8, 9

The most complete example is that figured in Plate 8, fig. 8 (here selected as the holotype), and it shows the impression of at least part of the early helicoid spiral and the Ancyloceratid final shaft, with the terminal but modified portion of the body-chamber preserved in the solid. The complete aperture meets the early spiral almost, but not quite, in the same plane. Length of the body-chamber and suture-line unknown.

The ribbing is fine on the second whorl and there is no slender and elongated, almost straight stage, following on the protoconch and smooth first whorl, as in *Protancyloceras* cf. *gracile* (Plate 8, fig. 4). Instead, the whorls merely lose contact and become helicoid, and where the spiral is about 3 mm. across there are some 24 to 30 fine ribs to the half-whorl, with the twist noticeable already at that stage. Unfortunately, among the many fragments there is not one that shows the change from the fine ribbing following the smooth stage to the coarse costation characteristic of the later whorls; but the ribs are distantly spaced and robust already when the helicoid spiral is only 6 mm. in diameter. The number of ribs then decreases from about 12 to 9–10 to the half-whorl, where it is 8–10 mm. The early whorls (Plate 6, fig. 11) are apparently less turreted than the later stage illustrated in Plate 8, fig. 9*b*, but the originals of fig. 4 (right-hand lower figure) and fig. 9*a* (lower specimen) and numerous other fragments are less extreme and merely helicoid.

The whorl-section is roughly circular, as in *Protancyloceras gracile*; where the whorl-height is 7 mm. (at the end) the thickness is slightly less. The ribs at first are radial and only show the helicoid twist, but towards the final portion they become modified and inclined forwards. They are then slightly curved and the ventral interruption disappears, the ribs forming a chevron on the periphery with the apex pointing forwards. The ventral lappet of the aperture is similar to that of *Protancyloceras guembeli* (Oppel) and *P. kurdistanense*, above described. Just before the aperture the ventral ribbing is rather irregular, compared with the more equally spaced and straighter early costation.

A large number of fragments of the present form were discovered in the matrix of other ammonites, e.g. *Phanerostephanus*, *Nothostephanus*, *Pseudolissoceras*, and the micromorph *Nannostephanus* which is equally common. The fragments are easily recognized by the twist in the ribbing and the rapid increase in curvature; they are much too stout to be confused with the early Leptoceratid stage of the very finely ribbed *Protancyloceras*. There may be a distinct sinus, directed forwards, on the ribs of the venter, but the siphonal interruption of the costae, though present, cannot always be clearly seen in the crystalline, bituminous matrix.

IV. THE AGE OF THE FAUNA

The fauna described in the preceding pages consists of the following nineteen species:

Oxylenticeras lepidum sp. nov.
Glochiceras (?) sp. juv. ind.
Glochiceras (?) sp. nov.
Pseudolissoceras zitteli (Burckhardt)
Pseudolissoceras advena sp. nov.
Lamellaptychus sp. ind.
Phanerostephanus subsenex sp. nov.
Phanerostephanus hudsoni sp. nov.
Phanerostephanus intermedius sp. nov.
Phanerostephanus dalmasiformis sp. nov.
Nannostephanus subcornutus sp. nov.
Nannostephanus sp. ind.
Nothostephanus kurdistanensis sp. nov.
Proniceras garaense sp. nov.
Proniceras simile sp. nov.
Proniceras sp. nov. ? ind.
Protancyloceras kurdistanense sp. nov.
Protancyloceras sp. aff. *gracile* (Oppel)
Cochlocrioceras turriculatum sp. nov.

To these may be added several varieties and related forms, referred to in the descriptions but not named separately on account of defective preservation; also *Virgatosimoceras* sp. nov. ind., which was received after completion of this paper. Although only a body-chamber fragment, it is almost certainly entirely new.

Altogether then there are 20 species (over 200 specimens), no fewer than 16 of them new, and only *Pseudolissoceras zitteli* and *Protancyloceras* aff. *gracile* are attached to known forms, whilst *Glochiceras* (?) sp. juv. and *Lamellaptychus* sp. ind. belong to long-lived, rather indifferent types of little stratigraphical importance. *Pseudolissoceras zitteli* is probably the most valuable of all the forms for dating the fauna, especially as it occurred together with the two distinctive genera *Proniceras* and *Protancyloceras*. It is a species of the Middle Tithonian of Argentina and has more recently been recorded from the approximately equivalent Viñales Limestone of Cuba (Imlay, 1942), where it is also associated with abundant forms of *Protancyloceras*. Some of these, like one of the Kurdistan species, can be compared to *P. gracile* (Oppel), a form of the 'older' Tithonian of Zittel.

This last term must not be confused with what is called the Lower Tithonian stage in the following pages. It denotes rather a miscellany of fragmentary and often condensed deposits, generally highly metamorphosed, or marmorized, ranging from the Upper Kimmeridgian to possibly high up in the Upper Jurassic; for the Rogoznik Breccia, for example, one of the best-known deposits of this 'older' Tithonian, was said to include also a number of forms characteristic of the Upper Tithonian Stramberg Limestone.

These classical, if disconnected, deposits give a very inadequate idea of the duration of Tithonian time, so that before discussing the exact age of the fauna here described it seems advisable to consider the more recent interpretations given to the Tithonian stage. In the absence of unequivocal type-successions which exist for the Kimmeridgian and Portlandian stages, the extent of the Tithonian is still matter of controversy; and the correlation of the freshwater Purbeck Formation or the supposed boreal Volgian with the marine Tithonian remains problematical. In the circumstances I may summarize my own change of view as follows.

When in 1913 I spoke of the '*Acanthicus* Beds' as including both the Upper Kimmeridgian and the Lower Tithonian, I visualized the former as corresponding to Haug's (1909: 1088) zone of *Oppelia lithographica* and the latter to his zone of *Perisphinctes contiguus*, the identity of the Lower Tithonian with the Portlandian being accepted by almost everybody without question. This left Haug's third zone, namely, the zone of *Berriasella privasensis*, as the equivalent of the Upper Tithonian. With Buckman (1922: 6–7) I soon realized, however, that this was far too simple a sub-division of the Upper Jurassic. In tables published in 1923 (p. 304) and 1924 (p. 20) I therefore intercalated the Portlandian between the Tithonian and the Kimmeridgian and lowered the position of the *steraspis* (or *lithographica*) zone, thus increasing the number of zones from three to nine. But, like Buckman and others, I still accepted Pavlow's (1896) and Salfeld's (1914) correlation of the Lower Volgian *Virgatites* beds with the Upper Kimmeridge Clay. It was not until I had worked out for myself the ammonite succession in the Kimmeridge Clay and the Portland Sands (1936: 162–3) and failed to find any true Virgatitids that I suspected that we had wrongly placed the Volgian below the Portlandian instead of above. At the same time it may be admitted that '*Provirgatites*', which precedes the true *Virgatites* in Russia, could be of Portlandian age; but the inner whorls of *Progalbanites albani* (Arkell) I figured from the Portland Sands (Spath, 1936: pl. xx, fig. 2; pl. xxiii, fig. 2; pl. xxiv. fig. 2) bear little resemblance to the restoration of that form published, as '*Provirgatites*', by Arkell (1947: 77, fig. 17, 2). I have not changed my opinion that neither *Provirgatites* nor the true *Virgatites* has yet been found in England.

In any case, I then also expressed the opinion that the distinctness of the fauna of the Rjasan beds from that of the Portland Stone suggested that there was room between them for far more than merely the *virgatus* beds and the Upper Volgian. One of the divisions I then had in mind and found unaccounted for was the whole of Buckman's somewhat problematical 'Proniceratan Age'. I also pointed out that there was no reason why the term Tithonian should not be used for all the beds of the uppermost Jurassic, i.e. all the marine post-Portlandian deposits, boreal as well as Mediterranean. But the real extent of the Tithonian remained uncertain.

From Mazenot's more recent work (1939) it appears that the late Professor W. Kilian made some errors in identifying certain French and other Mediterranean species and that, for example, *Berriasella privasensis*, which most authors had hitherto taken to characterize the topmost zone of the Jurassic, is commoner in the lowest Cretaceous than in the zone that bears its name. I am not in a position to dispute that, but I notice that Mazenot himself lists *Berriasella* 'of the *privasensis* group' from his Lower Tithonian, far below the old *privasensis* zone. Again, that author held that the position of the two sub-zones in the *privasensis* zone should be reversed, i.e. that the *chaperi* and *delphinensis* sub-zones, as adopted from Kilian on previous occasions (e.g. Spath, 1933: 864), are in the wrong order.

I am quite willing to accept a new name for the old *privasensis* zone, if necessary on account of the long range of that species, and I am meanwhile using the more or less equivalent terms *chaperi* and *delphinensis* in Mazenot's sense. But I am sceptical concerning the same author's interpretation of the earlier beds in the Tithonian and consider it quite illogical to include in the Lower Tithonian the *lithographica* zone, as Mazenot does. It is now known to be of Middle Kimmeridgian age, includes such typical genera as *Gravesia* and *Hybonoticeras* (= '*Waagenia*'), and cannot possibly be referred to the (presumably post-Portlandian) Tithonian stage.

Mazenot assumed a gap at the base of the old '*privasensis* zone' in the French Mediterranean succession and thought that the Berriasellids existing during this period were intermediate between those of the Chomérac fauna above and the Neuburg assemblage below. I may here put in a strong objection to the term Palaehoplitidae used by Mazenot for these and other ammonites; it is a pseudo-family name adopted from Roman (1938); it has no legal standing as a systematic unit; and it is meaningless as a popular term. In any case, Mazenot figured examples of certain species, e.g. '*Berriasella*' *subcalisto* and '*Neocomites*' *beneckei*, from both the Chomérac- (Upper) and the St. Concors- (Lower) Tithonian which does not speak in favour of a large gap. Unfortunately the examples of *N. beneckei* figured by Mazenot do not seem to belong to the same species. The typical Upper Tithonian forms (fig. 9) are rather involute and the ribbing shows low branches as in the young *Substeueroceras koeneni* (Steuer), whereas the St. Concors example (fig. 8) has ribs with short branches and a comparatively open umbilicus. Neither of the French forms is identical with Steuer's *Parodontoceras beneckei* which according to Gerth (1925) and Burckhardt (1930) belongs to the zone of *Spiticeras acutum*.

Similarly '*Berriasella*' *ciliata* (Schneid), the index-fossil of Mazenot's upper half of his Lower Tithonian (or '*contiguus*-zone'), is said to persist in the Upper Tithonian *chaperi* sub-zone and to range up into the Cretaceous (Berriasian). This is far too long a range for a specialized ammonite, not belonging to the stable, smooth families, such as the long-lived *Ptychophylloceras ptychoicum* or *Haploceras elimatum*. Moreover, it is not explained why '*B.*' *ciliata* was taken as index-ammonite of a horizon in the lower half of the Tithonian if it persists into the Cretaceous.

Schneid's Neuburg ammonites are difficult to place, as various authors, including myself, have discovered. They may have misled Blanchet (1923) when recording Neuburg species from St. Concors as well as from the presumed equivalent assemblage of Rochefort, near Grenoble; for I certainly cannot see much resemblance between Schneid's constricted 'Pseudovirgatitids' and the unconstricted Berriasellids figured by Mazenot, who accepted Blanchet's identification of the St. Concors and Rochefort faunas with that of Neuburg.

The latter, i.e. Schneid's so-called '*ciliata*-fauna', I have always considered to include a mixture of forms from different horizons, though in 1935 I stated that it did not comprise any pre-Portlandian types. This I had believed probable at first (1925) on the strength of the extraordinary resemblance of some of Schneid's ammonites (*Perisphinctes constrictor*, *P. caesposus*, pars, pl. xii, fig. 3) to *Pallasiceras* and *Pectinatites* of the Upper Kimmeridge Clay, and that view may still be correct. I pointed out at the same time that the Neuburg fauna did not contain a single Tithonian element in the STRICT sense, i.e. any ammonites from the true Upper Tithonian. I am ready now to accept the main Neuburg fauna as falling within the post-Portlandian Jurassic, though not the Upper Tithonian, as claimed by Schneid; but considering that these Neuburg ammonites came from a thickness of beds of over 130 ft. and that they are separated from the underlying Solnhofen beds (*steraspis* zone) by some 330 ft. of limestones and shales with undescribed ammonites, I am still doubtful whether the assemblage described by Schneid can be spoken of as a uniform '*ciliata*-fauna'. In any case, the ammonites from St. Concors figured by Mazenot as '*Berriasella*' aff. *praecox*, '*B.*' *pergrata*, and '*B.*' *adeps* do not appear to me to agree with Schneid's Neuburg originals (my *Parapallasiceras*) nor to be related to those curious *Anavirgatites* and *Pseudovirgatites* that give such a special stamp to the Neuburg fauna. Some of these I described (1925, 1935) from as far afield as British Somaliland, and *Anavirgatites* also occurs in Chile, where a form (*Anavirgatites* **baylei** nom. nov. for *Amm. bifurcatus* Bayle & Coquand, *non* Schlotheim, 1851: 20, pl. ii, fig. 2) was described many years ago, but like other Chilean biplicate ammonites remained unnoticed. The *Anavirgatites* fauna of Somaliland, in the Daghani Section (Spath, 1935: 206), is some 700 ft. higher than Middle Kimmeridgian ammonites (*Streblites*, *Hybonoticeras*), which hardly agrees with Mazenot's placing of these forms (of the *lithographica* zone) in the same lower half of the Tithonian.

The six beds of the *Diphya*-Limestone of Le Pouzin, with '*Perisphinctes*' *contiguus*, and conceivably other deposits, e.g. *Aptychus* beds and limestones with nothing more representative than the long-lived *Phylloceras*, *Lytoceras*, or *Haploceras*, no doubt come within the large gap between the restricted Neuburg fauna and the Middle Kimmeridgian *lithographica* zone, but the fact, stressed by Mazenot, that there are many Perisphinctids is not of much significance. For it may be remembered that there are over 200 ft. of beds with *contiguus*-like ammonites in the Upper Kimmeridge Clay (my *grandis* and *wheatleyensis* zones, 1936), and these are succeeded by higher Kimmeridgian and Portlandian ammonite faunas teeming with Perisphinctids which represent another 725 ft. of deposits. They are not accounted for in Mazenot's scheme and certainly cannot be included in a true Tithonian. But I am unable to say whether the fauna of Le Pouzin is a strictly homogeneous fauna or even whether it is entirely post-Portlandian, as the abundance of late types like *Kossmatia richteri*, *Semiformiceras fallauxi* (Oppel), &c., suggests.

A correlation of the few zones recognized by Mazenot in the south of France with those given by Burckhardt and Imlay for the Mexican and by Leanza for the Andine Tithonian is attempted in the following table. But this correlation is tentative and is meant to show where the beds of Jebel Gara that yielded the present fauna (and the succeeding assemblages briefly referred to) are believed to come in. Thus I am retaining the older divisions of the *Substeueroceras* beds, simply because several assemblages (with different species) have been collected on Jebel Gara; to recognize only one *koeneni* zone, as Leanza does, might give a misleading picture. Then the name *tenuistriata* zone, dating from 1923, is used for the *Kossmatia* beds, instead of *pseudodesmidoptycha* zone (Krantz, 1926; Burckhardt, 1930); for that Andine species with tuberculate inner whorls seems to be widely different from the true Indian *tenuistriata* group.

The genus *Kossmatia* is still imperfectly understood. Mazenot (1939) considered his '*Berriasella*' *richteri* (Oppel) to range from the Lower Tithonian into the Cretaceous, which is obviously impossible. In fact, the true *Kossmatia richteri*, refigured by Mazenot, is quite different from the Rogoznik *Perisphinctes richteri* figured by Zittel (1870: pl. xxxiii, fig. 4 only). This has the graceful ribbing and small umbilicus of *Grayiceras* and connects directly with *G.* **kiangurense** nom. nov. (for '*Simbirskites*' n. sp. ind. in Uhlig, 1910: 275, pl. lxxxi, fig. 2), which itself leads, by way of another new Spiti species (No. 83939, with wider umbilicus and closer costation) to the typical *Kossmatia*. In this, as in the closely allied *Paraboliceras* Uhlig (connected with *Kossmatia* by *K. desmidoptycha* Uhlig), the ribs, in the nepionic stage only, are blunt and comparatively coarse, bifurcating or single, inclined forwards as a whole, and not at all or at least not appreciably effaced in the siphonal line. Strachey's smaller example of *K. tenuistriata*, badly figured in Salter and Blanford (1865: pl. xv, fig. 2), is another new species of the same group, as is the less umbilicate *K.* **decipiens** nom. nov. (for *K.* n. sp. ind. in Uhlig, 1910: 276, pl. xci, fig. 2), with equally sharp and short secondaries on cast or test. But I am not in a position to say whether the Mexican species of *Kossmatia*, which according to Imlay are larger and more numerous than those of any other country, are as close to the European and Indian forms as that author believes.

There is some uncertainty about the next lower zones of the Upper Tithonian because the identifications of '*Neocomites*' *kayseri* (Steuer) and *Berriasella calistoides* (Behrendsen) adopted as zonal ammonites by Burckhardt (after Krantz) are open to doubt. The former species could be a late form of the *occitanica* group and in any case was associated with higher Tithonian types at La Manga. The other is one of the various controversial border-line species; it was recorded by Weaver from his Upper Tithonian; by Leanza from the higher *Substeueroceras* beds at the top of the Tithonian; Mazenot had it from the lowest Cretaceous of the south of France; and I used *Parodontoceras calistoides* (after Kilian) as an alternative name for the *calisto* zone at the base of the Berriasian.

For the lowest zone, at the base of the Upper Tithonian, I am adopting Leanza's zone of *Windhauseniceras internispinosum* (see p. 131). According to Krantz this form occurred together with such an early type as *Aulacosphinctes colubrinus* (*non* Reinecke), also with *Corongoceras lotenoense*. If *C. alternans* (Gerth) is found to occupy a distinct level above *C. lotenoense* (and *C. mendozanum* of Burckhardt's *calistoides* zone), Leanza's name *alternans* zone is available for the intermediate zone left unnamed in the table below.

The two zones of the Middle Tithonian are adopted from Burckhardt (1930: 112, table 11), but it is doubtful whether these and the few zones of the very incompletely known Lower Tithonian are sufficient to accommodate even the faunas so far described. There are serious objections to the continued use of the term *contiguus* zone for this Lower Tithonian. In 1925 and 1930, when putting this species in the genus *Subplanites*, I took it to be of Upper Kimmeridgian age, though previously

(1923) I had called it a Tithonian *Aulacosphinctoides* and had, in fact, suggested the term 'Aulacosphinctoidan Age' in place of '*contiguus* zone' which was retained merely because it was better known to the general geologist (p. 305). Both views are probably right. Unfortunately the revision of the diverse species that have been included in *Amm. contiguus*, considered desirable already by Uhlig (1910) and Neaverson (1925), is still outstanding. Meanwhile I can only suggest that the resemblance of some forms, e.g. the alleged Stramberg *Perisphinctes* (*Virgatosphinctes*) cf. *contiguus* (Catullo) of Blaschke (1911) to the genus *Virgatosphinctoides* Neaverson of the Upper Kimmeridge Clay, and of others (e.g. Uhlig's) to the associated *Aulacosphinctoides* of the Spiti Shales, is a case of heterochronous homoeomorphy, comparable to that of the Callovian and Argovian '*Macrocephalites*'. There are differences in the suture-lines and in other still less obvious characters, such as the ribbing, constrictions at different stages, &c., perhaps even the appearance in thin, median sections. There is, of course, also the possibility that the alleged horizons of some marmorized ammonites from the Alpine-Mediterranean Tithonian are unreliable.

Apart from the rearrangement of the zones and sub-zones, one important change now made in comparison with previous tables consists of the transfer of the *Virgatites* beds of the Volgian from the Upper Kimmeridgian to the post-Portlandian. The true *Virgatites* fauna (which does not include certain other Volgian ammonites often grouped with it) could be as late as the upper half of the Eo-Tithonian, not necessarily a counterpart of the *ciliata* zone, but probably not higher. This means that Pavlow must have been wrong in correlating with the Portland Stone the sands containing large ammonites that follow on the phosphatic conglomerate with '*Virgatites*'; for those lower beds of the so-called Volgian that succeed the Kimmeridgian *pseudomutabilis* zone and include first *Gravesia* and then *Pectinatites* and *Pavlovia* are clearly a condensed representation of the Upper Kimmeridge Clay and the Portland Sands (see above, pp. 97, 128).

The ammonites figured by Buckman as *Virgatites pallasianus* (d'Orbigny) and *V. scythicus* (Michalski), by Arkell as *Provirgatites*, and by myself as *Progalbanites*, like the East Greenland *Epipallasiceras*, &c., are all forerunners of the true *Virgatites*. I did not realize in 1923 what a mixture of forms of different ages had been included in '*Virgatites*'; and though I mistrusted the Kachpur sequence I gave, on the basis of Blake's collecting, it did show that the *Virgatites* and *Epivirgatites* fauna immediately preceded the Upper Volgian *Craspedites* faunas. The opinion then expressed that the latter might be boreal equivalents of the Tithonian *Proniceras* and *Haploceras*, though now shown to be correct, was unfortunately vitiated by the general belief that Salfeld's researches had settled the age of '*Virgatites*'.

On the other hand, it would be unsafe in the present state of our knowledge to stress the apparent affinity between the presumably later genera *Nothostephanus* and *Phanerostephanus* here described and their Volgian counterparts *Virgatites* and *Epivirgatites* (*nikitini* group) respectively. Altogether, the Virgatitinae (and 'Pseudovirgatitinae') are not now considered to be so fundamentally different from the Virgatosphinctinae, as Uhlig (1910) thought, and there are many passage-forms between the latter and the persistent *pseudocolubrinus* root-stock. Hence they also tend to resemble occasionally some of the genera grouped in the more or less parallel development, the Pavlovinae, until finally the presumed last survivor of the Perisphinctid stock, *Virgatosphinctes transitorius* (Oppel), became extinct in the Neo-Tithonian. It does not differ essentially from its presumable forerunners of the type of *V. pompeckji* Uhlig (1910: 320, pl. lxv, fig. 1); but its ephemeral ventral groove shows that it is already transitional to the rapidly rising Berriasellidae.

The *Craspedites* zones of the Upper Volgian then falling naturally into the Middle Tithonian, correlation is possible between the Russian *Riasanites* and its Andine equivalent, *Corongoceras*, of the lower Neo-Tithonian.

The earlier *Virgatosphinctes* beds of Madagascar, of Kachh, and of the Spiti Shales may all be of slightly different ages and perhaps not one is the exact counterpart of the well-known deposit of Le Pouzin or of the Andine *V. mendozanus* zone of Burckhardt. They are now all provisionally included in the *contiguus* zone or the *pseudocolubrinus* beds (s.l.) of the Lower Tithonian, and therefore considered to be post-Portlandian; for the true Portlandian ammonite fauna, perhaps unknown from any part of the world except southern England and the Boulonnais, is closely connected with that of the Upper Kimmeridge Clay and forms part of the same Pavlovian age. As already mentioned (p. 97), this may link up with the *pseudocolubrinus* beds of the table below, but is widely separated from the Berriasellan age of the Upper Tithonian.

Table of Emended Divisions of the Tithonian

TITHONIAN, Neo-	'privasensis'	chaperi delphinensis	Substeueroceras beds	permulticostatum acutum koeneni	*s, t, u*
TITHONIAN, Neo-	'pronus'		Kossmatia and Durangites beds	tenuistriata	
TITHONIAN, Meso-		(gap)	(?) Pseudolissoceras beds	internispinosum colubrinoides zitteli	*i*
TITHONIAN, Eo-	'contiguus'	St. Concors Le Pouzin	Pseudocolubrinus beds	. . . . ciliatum . . . . Virgatosphinctes	

With regard to the ammonites here described, it may be mentioned that although the great majority came from one bed (*i*) on Jebel Gara, 33 ft. thick, they were not collected inch by inch. At first sight they seem to belong to one uniform assemblage, however, for not only in the matrix of examples of *Pseudolissoceras*, but also in that of various species of *Phanerostephanus* and *Nothostephanus*, and even *Proniceras*, there occur fragments of *Nannostephanus subcornutus* and of *Cochlocrioceras*. These are the two commonest forms in the bed, so that the ammonites are at least largely, if not entirely, from one horizon. The presence of *Pseudolissoceras* suggests a horizon in the Middle Tithonian in which the Berriasellidae, so characteristic of the Upper Tithonian, played as yet a very minor part, while the Perisphinctids, dominant in the Lower Tithonian, were correspondingly more numerous. There is no evidence for considering *Proniceras* to have come from a higher level on Jebel Gara than *Pseudolissoceras*.

A few specimens have been added which are not from Jebel Gara but from another locality to the west (Shiranish Islam, Zakho District). They are apparently from a bed of about the same age, and if left out of this account would not affect the general conclusions. Yet it is interesting to note that though there are several specimens of *Oxylenticeras* and *Protancyloceras* from this second locality, there is no example of either *Nannostephanus subcornutus* or of *Cochlocrioceras turriculatum*, the two commonest ammonoids in the Jebel Gara fauna. *Pseudolissoceras zitteli* is also absent; but there are several complete examples of *P. advena* sp. nov., as already mentioned, in addition to bad impressions that must remain under suspicion because the collection from Shiranish Islam also contains a Lower Kimmeridgian *Sutneria* in a similar preservation (brownish calcite in a black bituminous matrix). Moreover, the ten forms of ammonoids here figured from that locality are either new or else not quite the same as their counterparts in the Jebel Gara fauna. They are:

Plate 6, figs. 3, 5. *Oxylenticeras lepidum* sp. nov., varieties
fig. 7. *Glochiceras* (?) sp. nov.
fig. 10. *Pseudolissoceras advena* sp. nov.
fig. 12. *Nannostephanus* sp. ind.
figs. 13, 14. *Protancyloceras* sp.
Plate 8, fig. 3. *Phanerostephanus intermedius* sp. nov.
fig. 5. *Nannostephanus* (?) sp. ind.
Plate 10, fig. 12. *Lamellaptychus* sp. ind.

The assemblage as a whole is in a less favourable state of preservation than that from Jebel Gara, but there seems to be no doubt that the two faunas are not exactly synchronous. The fact that the second assemblage includes a large example of *Proniceras*, apparently identical with *P. simile* from Jebel Gara, may be taken to indicate that the difference in level is only slight.

The genus *Proniceras* is said to be essentially Upper Tithonian. All the French forms figured by Djanélidzé (1922*a*) are referred to that sub-stage, and they are nearly all from Chomérac (Ardèche) and associated with *Spiticeras*. Imlay (1939) described species from the *Substeueroceras* beds of Mexico, without *Spiticeras*; and while he questioned the correctness of Burckhardt's (1930) placing of his *Proniceras* bed, Imlay insisted that the stratigraphical position of that genus was above that of *Kossmatia* and not below.

That, however, may not be true for all the forms of *Proniceras*. The name *pronum* zone is no longer applicable if *P. pronum* itself is confined to the uppermost (Stramberg) Tithonian. Proniceratan age (Buckman, 1922) seems preferable, but is not really helpful, while the range of the genus *Proniceras* remains unknown, and the same might apply to the Kossmatian Age which I substituted in 1923. But it is possible that *Proniceras* is connected by intermediaries with forerunners like the 'Lower Tithonian' *Pseudosimoceras* (group of *Olcostephanus stenonis* Gemmellaro); for it may be remembered that Kilian (1889) identified this early species with Pictet's *Amm. narbonensis*, a form now included in the very advanced *Spiticeras* (*Kilianiceras*). This connexion would make the affinity between *Proniceras* and the *colubrini* less close than was suggested above (p. 120), but Simoceratidae have been held to be Perisphinctid derivatives, showing the essential similarity of these stocks.

The ammonites of the *Proniceras* bed of Burckhardt (1930: 57, text-figs. 18*a–c*) in any case do not include *Substeueroceras* of the overlying shales. On the contrary, they are associated with species of *Aulacosphinctoides* (one of them transitional to *Micracanthoceras*), comparable to forms of the Spiti Shales and Madagascar which do not appear to be of high Tithonian age. In view of the coexistence in the present fauna of *Proniceras* with *Pseudolissoceras* and the other distinctive genera, but a complete absence of Berriasellidae, also the fact that this fauna came from a bed over 250 ft. below the top of the Jurassic, it might well be considered to be of pre-*Kossmatia* age, if not actually Middle Tithonian, the age of *Pseudolissoceras* in South America. To see this in true perspective, however, it should be remembered that the zone of *Pseudolissoceras zitteli* alone, i.e. Weaver's (1931) Middle Tithonian, in central Neuquen (Vaca Muerta Region), includes some 660 ft. of black shales and limestones out of a total thickness of 2,660 ft. for the Tithonian in Weaver's interpretation, that is WITHOUT the *Substeueroceras* beds. The Kurdistan succession, or at least the fossiliferous portions outlined on p. 97, therefore probably includes only disconnected fragments of the Upper Tithonian, with the new fauna here described from bed *i* at its base.

There is a possibility that the Kurdistan species of *Pseudolissoceras* are not isochronous with the Andine *P. zitteli*, and that in spite of a smaller umbilicus they are closer to the Carpathian *P. planiusculum* (Zittel), although this also is a form of the 'older' Tithonian and has not been found at Stramberg. To what has been said on p. 102 I can only add that the differences are very slight and that all the species of *Pseudolissoceras* may well come from one horizon. The coexistence of that genus with typical *Simoceras* (*volanense* group) in the Argentine Andes and in Cuba as well as in Europe makes it probable that it is not of high Tithonian age.

Another possibility is that the fauna from bed *j*, a 48-ft. bed of black shale, overlying bed *i* (which yielded the ammonites here described), is already of high Upper Tithonian age, in spite of its position at over 200 ft. below the top of that stage. The evidence is not conclusive, for half the fauna of bed *j* consists of a form that has the graceful, sigmoidal, lateral ribbing and the small umbilicus of *Grayiceras*, but the ribs are not projected appreciably at the ventral end. All the twenty-five specimens, however, are crushed, and not one shows the periphery. Then there are five specimens of what appears to be *Substeueroceras* ? *striolatum* (Steuer) and one new form, with the inner whorls more finely ribbed than those of *S. koeneni* (Steuer), but the outer whorl considerably more degenerate (in ribbing) than that of the much larger holotype of Steuer's species. There is only one crushed periphery of a typical, large *Substeueroceras*.

Parodontoceras is also represented by only one example, comparable to *P. beneckei* (Steuer), but this must belong to a persistent group, for the ammonite is not very different from a form of the same genus, doubtfully attached to *P. calistoides* (Behrendsen) from bed *s*, about 150 ft. higher in the succession. An impression of a *Spiticeras* with Perisphinctoid inner whorls, resembling *S.* (*Kilianiceras*) *chomeracense* Djanélidzé, could also belong to the zone of *Spiticeras acutum*, like *Parodontoceras beneckei*.

The rest of the Berriasellids (and Perisphinctids ?) of the latest collection from bed *j* are not readily identifiable. They include impressions of several large forms, notably a fragment of a *Substeueroceras* like *S. ellipsostomum* (Steuer) of the *koeneni* zone. Another distantly resembles the fragment figured by Burckhardt (1906: pl. xxxviii, fig. 2) as *Hoplites* cfr. *calisto* Zittel (*sic*), but it has peculiarly flattened ribs. A third form has a diameter of 170 mm. and is apparently undescribed, for I cannot even suggest a genus for it. It has straight, distant costation on the earlier whorls, exposed in the wide umbilicus, but the smooth outer whorl has strong and short secondaries only near the ventral edge. There is no indication of the original appearance of the periphery. I may add that I am not here recording a fair number of recognizable examples of Berriasellids said to have been collected 'from the scree of bed *j*' (old collection) because they may have come down from higher beds.

On the whole, then, the fauna of the bed overlying bed *i* that yielded the ammonites here described lacks the typical Berriasellids of the uppermost Tithonian as well as *Proniceras*. The dominant genus, *Grayiceras*, is known to be associated with *Kossmatia* in Mexico, and it probably occupies the same horizon in the Himalayas where its companion genus is *Paraboliceras*, in place of the Mexican *Durangites*. In other words, bed *j* would probably come within the *tenuistriata* zone of the above table, although three of the species mentioned have been found in the higher *koeneni* and *acutum* zones. But while the beds with *Kossmatia*, *Durangites*, and *Grayiceras* are taken to be of Upper Tithonian age, these ammonites are not associated with any of the late Tithonian forms of *Berriasella* of the *delphinensis* type or of *Protacanthodiscus* (*chaperi* group) described from, for example, Aizy (Isère) or Theodosia in the Crimea. These only occur in the top beds (*t–u*) of Jebel Gara.

If I am right about the stratigraphical position of the ammonites from *j* it may explain the absence of *Kossmatia* from bed *i* below. This, however, has yielded both the presumed later *Proniceras* and the earlier *Pseudolissoceras*, which perhaps indicates that either genus had a longer range than is generally believed. With regard to the first, it must suffice to point out that the Kurdistan species of *Proniceras* are different from those of Mexico or Chomérac (Ardèche). On the other hand, *Pseudolissoceras*, being a Haploceratid, i.e. one of the smooth, fundamental stocks, is more likely to have an extended range than the more specialized and ornamented *Proniceras*. On the whole I am not in favour of assuming long ranges of certain ammonite genera to explain an apparent anomaly, unless there is far more convincing evidence than in the present case. There are as yet too many gaps in the succession and in our knowledge of the Tithonian stage to be dogmatic. Thus it is almost certain that the forms of *Kossmatia* from Imlay's (1943) locality 17252 are widely separated, stratigraphically, from the beds that yielded his *Subplanites* and *Virgatosphinctes* at the same locality, as, indeed, the difference in matrix and preservation had already suggested to Imlay. It may not be out of place in this connexion to emphasize that this fauna from locality 17252 itself occurred hundreds of feet above beds with *Hybonoticeras* ('*Waagenia*') according to the collectors, W. S. Adkins and R. E. King. There is room here yet for other new and unsuspected faunas, as there is in the corresponding gap between the Middle Kimmeridgian and the *Anavirgatites* beds (*ciliatum* zone) of Somaliland, referred to on p. 128.

The Tithonian, in short, is probably as incompletely developed in Mexico as in all the other countries so far explored, including Kurdistan, where there may be no Lower Tithonian at all.

The reader will probably have come to the conclusion that we workers on ammonites uphold the world-wide distribution of these organisms for reasons of convenience and because we would like to be able to determine more or less mechanically the age of a deposit by means of the ammonites. The present account, on the other hand, rather supports what I said in 1933 (p. 794), that it seemed there was indeed no means of exact—as distinct from approximate—parallelization of beds from one continent to another and that the different groups of ammonites did not modify in the same way and at exactly the same rate in the different provinces.

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PLATE 6

FIGS. 1–5. *Oxylenticeras lepidum* sp. nov. Side- and peripheral views of holotype (1*a*, *b* = C.41118). Side-view of another example (2*a* = C.41117) with crushed body-chamber and (2*b*) solid septate whorls reversed. Side- and peripheral views of a ribbed variety (3*a*, *b* = C.41119). Peripheral view of a small compressed example (4 = C.41120); and side- and peripheral views of an inflated variety (5*a*, *b* = C.41122). P. 99.

FIGS. 6*a*, *b*. *Glochiceras* (?) sp. juv. ind. Side- and peripheral views (C.41107). P. 100.

FIG. 7. *Glochiceras* (?) sp. nov. Terminal portion of body-chamber (C.41106). P. 101.

FIGS. 8*a–c*. *Pseudolissoceras zitteli* (Burckhardt). Specimen showing portion of ribbed body-chamber crushed on to septate, smooth whorls (8*a* = C.41115); also side- and peripheral views of another example (8*b*, *c* = C.41116). P. 101.

FIGS. 9–10. *Pseudolissoceras advena* sp. nov. Side- and peripheral views of holotype (9*a*, *b* = C.41110) and of a smaller example (9*c*, *d* = C.41109); also side-view of a specimen with narrower venter (10 = C.41186). For suture-line see Plate 8, fig. 10. P. 102.

FIG. 11. *Cochlocrioceras turriculatum* sp. nov. Typical fragment (left) and initial whorls and protoconch of same? (enlarged ×4). C.41156. P. 124.

FIGS. 12*a*, *b*. *Nannostephanus* sp. ind. Side- and peripheral views (C.41162). P. 111.

FIGS. 13, 14. *Protancyloceras* sp. Two crushed specimens (C.41158–41159) with resemblance to *P. catalinense* (Imlay). P. 122.

FIG. 15. *Phanerostephanus subsenex* sp. nov. Peripheral view of the example (C.40744) figured in Plate 7, fig. 6. P. 105.

All the specimens on this plate are from Jebel Gara, near Amadia, Kurdistan, except figs. 3, 5, 7, 10, 12, 13, 14 which are from Shiranish Islam, Zakho District.

TITHONIAN AMMONOIDS FROM KURDISTAN

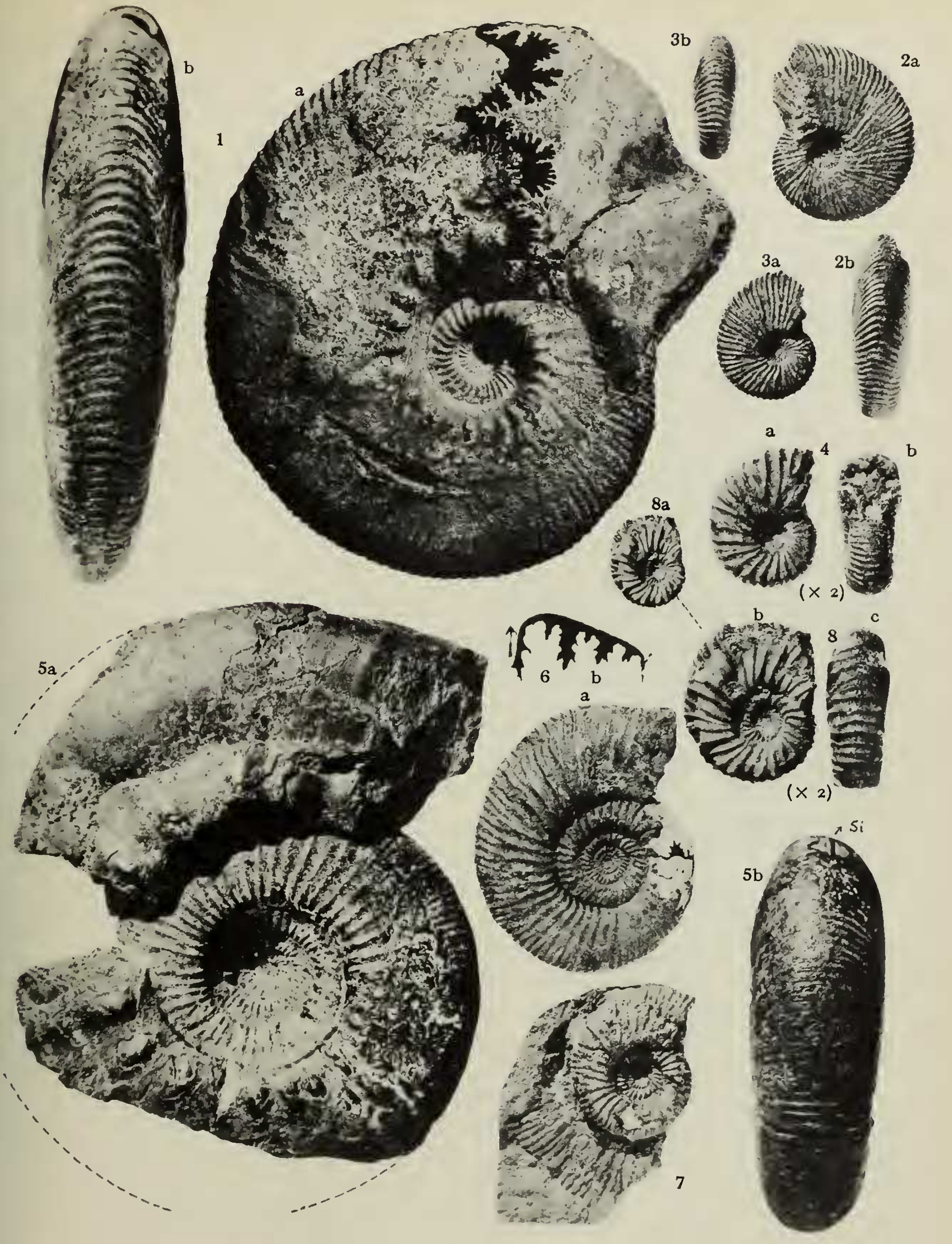
PLATE 7

FIGS. 1–4. *Nothostephanus kurdistanensis* sp. nov. Side- and peripheral views of holotype (1 = C.40745) and three young examples (2 = C.41111; 3 = C.41112; 4 = C.41113). P. 116.

FIGS. 5–7. *Phanerostephanus subsenex* sp. nov. Side-view of holotype (5*a* = C.41166) and peripheral view of its earlier whorls (5*b*); also two smaller examples (6 = C.40744; 7 = C.41184). 6*a* = suture-line, enlarged and restored from fig. 6*a* and the peripheral view in Plate 6, fig. 15. P. 105.

FIG. 8. *Nothostephanus* sp. juv. aff. *kurdistanensis*, sp. nov. transitional to *Nannostephanus*. Side-view (8*a* = C.41114) and side- and peripheral views enlarged ×2 (8*b*, *c*). P. 116.

All the specimens on this plate are from Jebel Gara, near Amadia, Kurdistan.



TITHONIAN AMMONOIDS FROM KURDISTAN

PLATE 8

FIGS. 1, 2. *Phanerostephanus hudsoni* sp. nov. Side- and peripheral views of holotype (1*a*, *b* = C.40746) and of a large septate fragment (2*a*, *b* = C.40749). P. 107.

FIGS. 3*a*, *b*. *Phanerostephanus intermedius* sp. nov. Side- and peripheral views of septate whorls of holotype (C.41130). Impression of outer whorl omitted. Shiranish Islam, Zakho District. P. 107.

FIGS. 4*a*, *b*. *Protancyloceras* sp. aff. *gracile* (Oppel). Slab with portions (left) of two larger examples and early whorls with protoconch (top, right); also fragment of *Cochlocrioceras turriculatum* sp. nov. (bottom, right). C.41155. P. 122.

FIGS. 5*a–c*. *Nannostephanus* (?) sp. ind. Side- and peripheral views of a doubtful young specimen (C.41129); also side-view enlarged ×2. Shiranish Islam, Zakho District. P. 111.

FIG. 6. *Phanerostephanus* cf. *intermedius* sp. nov. Doubtful crushed specimen (C.41131). P. 107.

FIG. 7. *Phanerostephanus dalmasiformis* sp. nov. Crushed holotype (C.41164). P. 109.

FIGS. 8, 9. *Cochlocrioceras turriculatum* sp. nov. Holotype, with portion of periphery near aperture (8*a*, *b* = C.41157) and paratype, with outline of top-left fragment, restored and enlarged from impression in rock (9*a*, *b* = C.41153). P. 124.

FIG. 10. *Pseudolissoceras advena* sp. nov. Asymmetrical suture-line, enlarged ×2, of a small example (? variety without umbilical edge) from Shiranish Islam, Zakho District (C.41187). P. 102.

All the specimens on this plate, except figs. 3, 5, and 10, are from Jebel Gara, near Amadia, Kurdistan.